

Brewer Gold Mine
11.9 Vol 3

BREWER GOLD COMPANY

EXHIBIT A

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*Brewer Gold Mine
11.9 Vol 3*

BREWER GOLD COMPANY
A PLAN TO ELIMINATE GROUND WATER CONTAMINATION
BY
ACID GENERATING MINE WASTE

April 12, 1999

by

Bernard Long P.E.
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00-102

Bernard Long

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BREWER GOLD COMPANY

LOWERING THE GROUND WATER ELEVATION TO STOP GROUND WATER CONTAMINATION BY ACID MINE WASTE

APRIL 5, 1999

INTRODUCTION:

Since backfilling the Brewer and B-6 Mine Pits and discontinuing pumping of the underground sumps, a number of acid springs began to flow toward Little Fork Creek. These springs appear to be the result of raising the water table, after backfilling, creating a cone of depression in the subsurface hydro-geologic topography whereby springs began to outcrop at the surface in low lying areas. There a number of these springs flowing from various locations around the perimeter of the Brewer Hill, some with typical ground water quality and some as acid mine water.

Where the springs are acid, it appears the ground water has been contaminated from the acid generating rocks surrounding the Brewer ore body and from acid mine rocks placed in the backfill during mining. In order to determine the feasibility of draining the water table to a level below the bottom the these pits, to avoid contamination of the ground water, Brewer management staff in conjunction with a South Carolina State Certified Geologist, Roger Callaway, have been conducting field studies, mapping the water table and measuring spring water flows, water levels as well as water quality. [Past operating practices prove that the ground water levels can be lowered by pumping, but it has not been determined if permanently lowering of the water table will eliminate the contamination of ground water by acid generating rocks in the backfill.]

By using current monitor well data, adding new monitor wells, and observing water levels and water quality in these wells during pump down tests, we can quantify pumping requirements, water quality and the effects these changes will have on treatment costs. The end result of the study is to prove that the ground water can be kept free of contaminants and that eventually the water table can be lowered by gravity methods with zero pumping costs, thus providing an avenue for Costain to eventually walk away from the property with no further obligation.

Callaway has completed his study, copy enclosed, which concludes after a number of days of field work that the water table subsurface hydrology generally follows the surface topography and is predictable. Ground water is contained in geological formations called aquifers which are sufficiently permeable to transmit and yield water. The more porous, the material, the higher yielding it is as an aquifer. In general, igneous and metamorphic rocks such as exist at Brewer do not make good aquifers except in areas where they are faulted and fractured. It follows that Brewer Hill is an isolated recharge zone of weathered, fractured and faulted metamorphic rocks, and it is fairly shallow in depth. The number of springs and volume of spring flows compares well with the percolation estimates of the annual rainfall. This conclusion, in a sense, tells us that once we have

lowered the water table to the optimum level, the flows are likely to remain at about the same volume as they are now.

PROCEDURES:

The State of South Carolina will require us to prepare a stringent plan of evaluating the theories presented here before they will allow us to proceed with any field work. They will expect results to be consistent over fairly lengthy periods of time before they will approve additional tasks. A schedule of tasks, time table, and annual costs is shown on the attachment for quick reference, however a detailed explanation follows:

Task One - Prior to preparing any documentation for the State Brewer personnel needs to drill four shallow monitor wells near the outlet of the B-6 spring to determine the difference in quality of ground water while pumping an existing internal sump, drying up the acid spring. This work has been started and testing will continue through April 1999. From this study we hope to show that the spring can be pumped dry and that better quality ground water will displace the acid water in the wells near the acid spring.

Task Two - With positive results from Task 1, we will need to obtain a Permit from the State to install six (6), 6" dia dewatering wells, drilled to a depth of 45 feet which is 10 feet below the floor of the B-6 Pit. The purpose of these wells is to allow for pumping of the water table to a permanent level, ten feet below the pit floor, to prevent ground water from contacting the acid mine rocks located there.

This study will be monitored closely for water quality and quantity. During this Task the water will be treated as usual before discharge, however it is anticipated that the amount of chemicals will be greatly reduced as water quality should improve substantially. The savings in treatment chemicals will be offset by the cost of the well installations. The State will expect a full year of data before going to the next Task.

Task Three - This task involves gravity drainage of the water table from the depth of the wells described in Task Two. This Task assumes the State has approved the quality of the ground water as suitable for direct discharge into the creek without any additional form of treatment. Little Fork Creek is located approximately 300 feet horizontally from the toe of the mine pit floor but it is also 20 feet lower in elevation than the pit floor (elev. 315'), thus allowing for a permanent gravity flow of ground water through a some sort of conduit.

A Cross Section of the B-6 Pit showing both a West to East view, (looking North) and a North to South View, (looking East) is shown on Page 36. Also, showing at the bottom of the B-6 Pit at Elevation 340' is acid generating waste rock placed there during mining operations. It is this material that is contaminating the groundwater as it flows in, mingles with the acid rocks, and flows and out of the Pit as a surface spring.

It can be seen, that by driving bore holes or an adit from the creek, elevation 315', to an elevation ten feet below the base of the Pit floor, (elev. 340') the water table could be drained by gravity, thus

eliminating ground water contact with the acid generating backfilled material. The ground water would drain into the creek similar to other ground water springs surrounding Brewer Hill. A permanent liner will have to be installed in the bore holes or the adit (tunnel) to prevent collapse in order for the State to allow Costain to walk away from this project. The State will require at least five to seven years of continuous monitoring of discharges from this adit before they are satisfied that the project is in full compliance with Brewer's National Pollution Discharge Elimination System permit (NPDES permit).

CONCLUSION:

IT
The attached schedule showing task, time table and costs, projects a cost of about the same as noted on previous estimates. Again, it assumes that the capital installation work will be off-set by much lower water treatment chemical costs. The work has been categorized as Contractor provided, or Brewer personnel assigned. So many routine assignments are required by the State that a few trained and licensed employees are required to be on the property for the duration of the project.

Based upon the assumption that current budget estimates and current manpower levels can be maintained, Brewer management request permission to proceed with this program of Permitting, Pumping and Draining the Water Table as Described above, with the Objective of eliminating Costain's exposure at Brewer, and their eventual release from State imposed liabilities on the property. Each Task is independent of the next, and should a fatal flaw develop during and Task, the project will be stopped and the project reevaluated.

Please note on the Drawing of the B-6 Pit Sectional View reference to a geo-synthetic cap *GCL* (GCL). This is an impervious cap installed at the completion of backfilling of both the Brewer and B-6 Pits. It consists of a layer of bentonite clay embedded between two layers of a synthetic fiber woven fabric and is guaranteed to have a porosity of 10^{-9} centimeters per second. On top of this cap is an additional 18 inches of clay material for protection. This cap is nearly impervious allowing no measurable flow. It is extremely important that the cap material not be penetrated and its integrity must be maintained as there are roughly six million tons of acid generating material packed beneath the cap but above the water table

APPROVED

Kenneth Bruce - Costain Group

Bernard G. Long - Brewer Gold Co.

**BREWER GOLD COMPANY
RECLAMATION & MAINTENANCE LIST**

Revised Plan: April 8, 1999

**BEST CASE PLAN
LOWER GROUND WATER ELEVATION**

CONTRACTOR PROVIDED - ROUTINE SERVICES										COMPLETE
NPDES Permit Required Sampling of Little Fork Creek Three Times per Year.										12/31/2008
Lime Application to Seeded Areas Annually										12/31/2008
Chemical Analysis of NPDES Discharge Water										12/31/2008
Chemical Analysis of Dewatering Well Water and Adit Drainage Water										12/31/2008
Chemical Analysis of "STATE" Selected Monitor Wells for Ground Water Quality										12/31/2008
CONTRACTOR ITEMS - SPECIAL PROJECTS										
Install Six (6) Shallow De-watering Wells at B-6 for Pumping out Ground Water										9/1/1999
Drive an Adit Beneath the B-6 Pit Floor to Gravity Drain the Water Table										3/15/2001
Backfill The North West Pit										4/30/2003
Dismantle Original Pit Water Treatment Plant										8/31/2004
Dismantle MgO Water Treatment Plant										8/31/2007
Dismantle All Brewer Buildings and Power Poles										10/30/2008
Develop Alternate Plans Using Passive Treatment For Ground Water Neutralization.										10/30/2000
BREWER PERSONNEL - SPECIAL PROJECTS										
Drill Three, 3-1/2" dia. Test Wells at B-6 for Monitoring Purposes										3/24/1999
Pump Internal Sump at B-6 Dry (Temporarily) for Study Purposes										4/30/1999
Record Fluctuations in Water Level in the Three 3-1/2" Test Wells										5/15/1999
Pump the 6 Ea. Contractor Installed Wells at B-6 to Ground Water Level										3/15/2001
Secure Permits for Leaving the Sediment Pond Dams and Pad 6 Dam in Place										4/30/2003
BREWER PERSONNEL - ROUTINE "STATE" NPDES OBLIGATIONS										
Treat and Discharge Acid Water Until <u>IT</u> Meets approved Ground Water Standards.										12/31/2001
Perform Daily & Weekly Monitoring Requirements According to NPDES Permit #SC0040657										12/31/2008
Submit to the Bureau of Water Enforcement Section a Quarterly Progress Report.										12/31/2008
Maintain Records of Monitoring Activities on a Three Year Basis										12/31/2011
Maintain All Weather Hard Surface Roads to the Site at All Times										12/31/2008
Maintain a Storm Water Pollution Prevention Plan Ready for Inspection at Anytime.										12/31/2008
BREWER PERSONNEL - ROUTINE RECLAMATION OBLIGATIONS										
Sample For Water Quality From the New Six (6) Dewatering Wells										3/15/2001
Sample For Water Quality Coming From the New Adit Beneath the B-6 Pit Floor										12/31/2008
Fertilize Seeded Areas Twice Annually										12/31/2008
Farm Waste Rock Dump in Small 2 Acre Tracts Until the 40 Acres is Finished										7/31/2006
Reseed Bare Spots on the Remaining 180 Acres Annually										12/31/2008
Remove Trees Growing on Cap,										Indefinite
POTENTIAL LONG TERM LIABILITIES										
In the event that lowering of the water table to a level below the Mine Pits does not result in ground water suitable for discharge, this water will have to be treated, but at a cost estimated to be much lower than at present - It is possible that a passive treatment method may be successful using a wetland cell.										
COST	1999	2000	2001	2002	2003	2004	2005	2006		2007
	680,000	500,000	900,000	300,000	250,000	200,000	180,000	150,000		150,000
								TOTAL		3,160,000

**A Summary Report of
Ground Water Features Observed at
Brewer Gold Company Property,
Chesterfield County, South Carolina**

Prepared for:
Bernard G. Long
Jim McClain
Brewer Gold Company

Submitted by
Litho-Logic Consulting Company Inc.
April 9, 1999



Roger Q. Callaway SCRG 201
President

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Conclusions

- 1.) The springs that surround the Brewer Hill reflect outflow from the crystalline aquifer created in pre existing rocks by weathering processes, and probably indicate the base elevation of this aquifer.
- 2.) The Brewer Mine Hill is isolated from the regional aquifer by a topographic saddle to the north at an elevation of 416' (above measn seal level elevation), and to the northeast and southwest by existing creeks at base elevations of 350' or less. Groundwater outflow above this elevation is from local groundwater recharge areas on Brewer Mine Hill.
- 3.) Acid springs above the sediment pond probably reflect drainage from the existing oxidized crystalline aquifer of accumulated contamination from the previously removed waste dump.
- 4.) Outflow from the B-6 Pit occurs near the lowest pit crest elevation and reflects filling of the B-6 pit by groundwater. The chemistry of this water is affected by contact with the backfill, and retention time before outflow occurs.
- 5.) The water level observed in Monitor well 14, and the general shape of the piezometric surface indicate that Brewer Pit backfill activities changed the groundwater levels of the area surrounding the Brewer Pit, relative to pre backfill levels.
- 6.) The outflow to balance an assumed inflow into the Brewer Pit has not been specifically identified.
- 7.) The B-6 Pit, and the Brewer Tunnel Drainage are probably largely isolated from each other.
- 8.) The Brewer Pit has contributed water to the B-6 pit in the past, probably via fractures, and may be doing so today.
- 9.) The Brewer Pit may be contributing water to the plugged drainage tunnel via underflow. If the tunnel is flooded by Brewer water, it could leak to the B-6 or the Limestone Sump below the tunnel portal.
- 10.) The absence of water flow from the Brewer Sub drain indicates an unidentified feature is draining water from the Brewer at an elevation below the Sub drain elevation.
- 11.) Because the elevation of the upper acid seep above the Brewer Tunnel Portal is above the Brewer Sub drain, it is suggested that there is a groundwater contribution from a source above the Brewer Subdrain.

Recommendations

- 1.) A more detailed model of the groundwater flow into the B-6 pit should be constructed. This would include investigation of the existence of water conducting fractures along the south wall of the B-6 pit, and delineation of the cone of depression into the B-6. Existing geophysical and structural mapping data should be examined. A VLF survey sometimes is useful in detecting water filled fractures, and would be relatively inexpensive.
- 2.) Strategies to examine the effect of lowering the water level in the B-6 pit on the B-6 water chemistry should be investigated. Pumping from the internal sump has dried up the B-6 acid spring in the past, and may remove part of the B-6 backfill from contact with groundwater. Marginal effects on the water chemistry may be observed just from pumping from the internal sump.
- 3.) The B-6 pit could be dewatered by intercepting the inflow through a well field, drainage from below by an adit or horizontal wells, or directly by angle wells into the pit toe from above.

Introduction

This is a summary report of an investigation of hydrologic conditions, including both surface and subsurface water, at the Brewer Gold Company property in Chesterfield County, South Carolina. The sources of information are a brief field investigation, interviews with current company personnel, and existing knowledge of the author, a former employee of the company.

Initiation

This study was initiated by, and under the direction of, the management of Brewer Gold Company.

Objectives

The study was undertaken to clarify existing hydrologic conditions at the Brewer Gold Property. The topics of particular interest were:

- 1.) The general character of the Brewer Hill aquifer.
- 2.) Hydrologic conditions of the back filled Brewer Pit and B-6 pit areas.
- 3.) The discharge from the B-6 pit.
- 4.) Identification of possible strategies for reducing treatment costs of discharge waters.

Scope and Conditions

This study was undertaken to characterize the hydrology of the Brewer Mine area, based on existing monitor well data, a brief examination of field conditions and on site interviews concerning backfill and water flow events. One of the tasks of this investigation was to identify avenues of continuing study that may prove useful. Because this report may form the basis of future investigations, in places the report is broad rather than deep. Rigorous treatment of every topic introduced here would extend the study far beyond the original brief field examination that was undertaken. All field activities occurred between February 14 and 26, 1999.

Previous Work

No previous studies of the groundwater conditions of the area were available, and may not exist. This report has relied on John Scheetz' 1991 thesis for some background geological information. The author was the mine geologist at the mine during the initial phases of mining. This experience has been of some use in this study.

Procedures

Interviews

As this study has progressed various topics have been reviewed and discussed with Brewer Gold Company staff. The investigation has largely been a joint effort.

Characterization of the Piezometric Surface (Water Table)

The summary map of groundwater measurements was scanned and a topo base extracted from it to clarify topography. This map was used as a base to contour water elevations for the piezometric map. The general assumptions used in creation of the piezometric map were that the aquifer was isomorphic, and that groundwater flows generally followed topography. The groundwater contours were assumed to be contiguous with the topographic contours where springs or active flows exist. It must be clearly stated that the piezometric map is an extrapolation from the limited data that is available.

A walking survey of the area was made to locate active seeps, springs, and water flows. Where these were encountered, a visual estimation was made of the flow rate, and the pH was checked with pH paper. The location of each active water source was plotted on a topo base.

A copy of water level measurements in the monitor wells was supplied by Brewer Gold to me. In some cases this data was graphed to better visualize water level variation.

All elevations given are feet above mean sea level.

Results

A review of the Brewer geology, topography and hydrology follows. A more detailed review of the hydrology of certain areas is attempted. A description of every outflow encountered is included as an appendix at the back of the report.

Topography

Regional

The Brewer Gold Mine property covers what is locally known as Brewer Hill, or the Gold Mine Hill, see figure 1. It is actually the southeast end of a ridge bounded to the northeast by Little Fork Creek, and to the southwest by Lynches River. To the southeast and east of the hill there is approximately 200 feet relief. Regionally elevations are slightly higher to the northwest, and descend to the south east, the direction of the stream flows.

Brewer Hill

The high point of the hill is at 600 feet. To the northwest, along the ridge, the hill is separated from the rest of the ridge by a saddle at 416' elevation. Elevations drop to 350' at the streams to the south east and northwest, and at their confluence to the southeast. The mine hill itself has a flattened top that slopes to the southeast from 600' to 500'. The dendritic drainage system of the area has incised numerous side drainages into the hill.

Topography of Brewer Gold Mine Area

Elevation 416

Brewer Property Line

Lynches River

Little Fork Creek

Jefferson

Birdtown

1" = 2000'

Geology

The geology of the Brewer Gold Mine area is dominated by the alteration effects associated with emplacement of the ore body. Some features that have a bearing on the hydrology of the area will be discussed.

Tanyard Syncline

A series of rocks with an east - west trend outcrops in the southern part of the mine hill. They cover the area underlying the office and the old waste dump up to the B-6 pit. Outcrop patterns of the rock sequence indicates a syncline that plunges from the B-6 area to the west. Though the outcrop pattern at the west end of the syncline is poor, previous workers have shown the rocks terminating at the west, and the syncline plunging east from near the office. The accepted interpretation has been that the Tanyard is a "canoe shaped" structural remnant floating in a sea of Brewer volcanics. The core of the syncline assemblage features argillites and very sericitic altered volcanic rock. As the Tanyard stratigraphy is traversed down section in the stripped area of the waste dump, the rocks look more and more like Brewer Rock. Identifiable Tanyard Rocks were seen at the 390 elevation in the B-6 pits, approximately 125' below the ground elevation of the waste dump area, and form the eastern ore body of the B-6 pit.

Southern Assemblage

The rock south of the Tanyard often shows a poor foliation or slaty cleavage. Though outcrop is poor a natural bench at the 400' elevation may be followed around the south end of the Brewer Hill and may be held up by a resistant bed.

Northern Assemblage

The outcrop within the Brewer pit and areas north appear to be an altered massive volcanic rock that is poorly foliated.

Structure

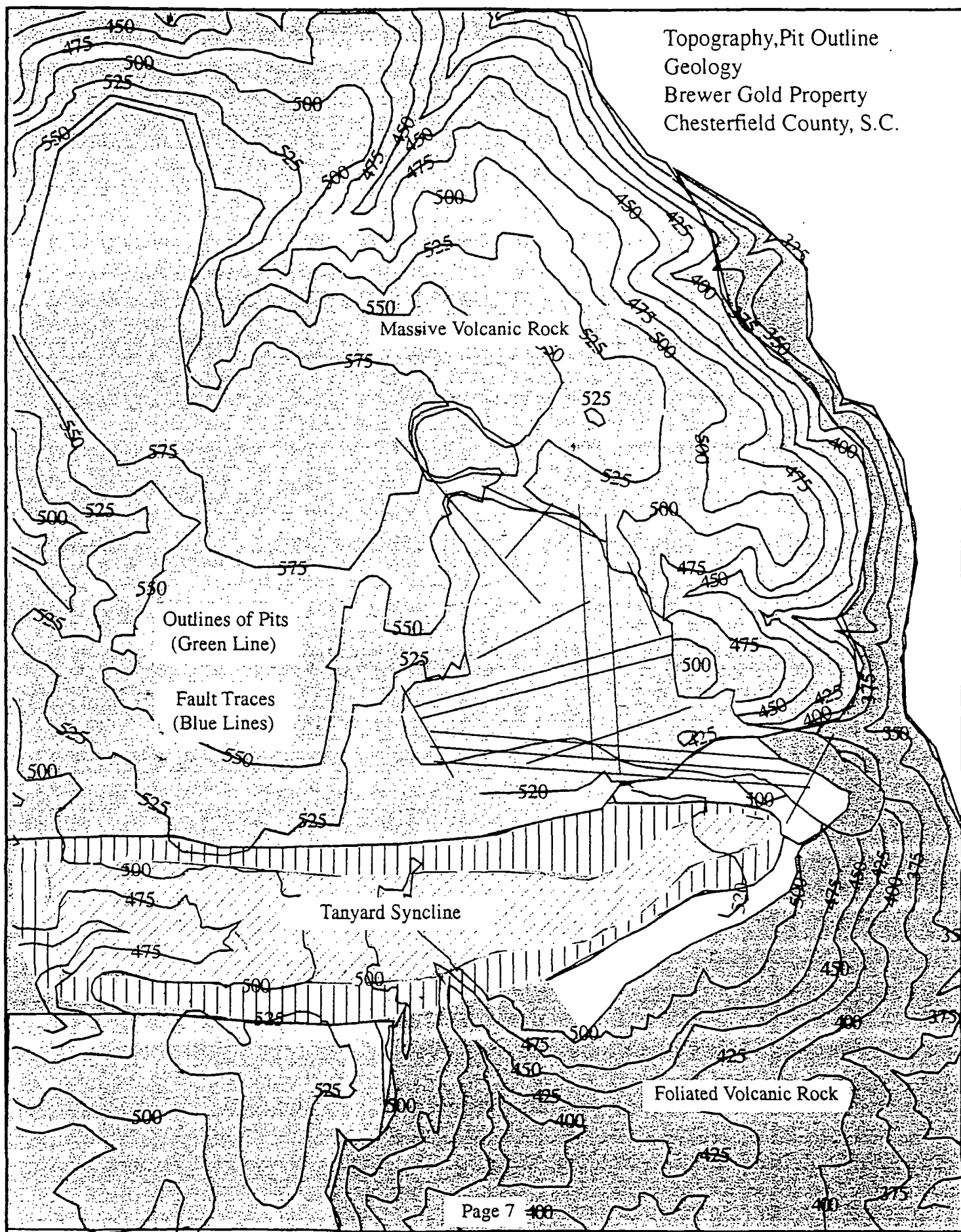
Fault traces from a structure map in Scheetz thesis were placed on the topography map in this report. Bounding faults are seen at the limits of the Brewer - B-6 pits. The shape of the ore body itself suggests that it occurred at the intersection of a northwest trending structure, and a northeast structure. These fault traces support that interpretation. For this study the affect of open fractured zones on groundwater movement should be kept in mind.

Patterns of erosion are often influenced by fault weakening of bedrock. Near the highest elevation of Brewer Hill, a paired drainage pattern indicates a structure with a northeast trend.

Geologic History

The Southeastern region of the United States is often sited as an example of peneplane development. Sediments filling the Triassic basins indicate active mechanical erosion of the pre Triassic highlands. After continental break up in the Triassic, the eastern margin of the North American craton was a passive continental margin. In the absence of mountain building processes, the area of the Southeastern Piedmont Province was reduced to a flat plain, dropping gradually to sea level. Since the development of this erosional surface, the dominant

Topography, Pit Outline
Geology
Brewer Gold Property
Chesterfield County, S.C.



weathering process has been chemical, allowing a deep saprolitic weathering profile to develop. Regional uplift has allowed present drainages to form the current dendritic drainage pattern in the weathered surface. In general, the topographic highs are underlain by deep weathering profiles, and bedrock exposures occur in the active stream drainages.

Local Weathering Effects

The end product of saprolitic weathering is often a red "cap clay" with no residual rock texture. This cap clay overlay the area of the waste dump, and pad 5 on Brewer Hill. The area under pads 1-4 were underlain by a sandy saprolite. Pad 6 was underlain by rocky outcrop. The Tanyard area had been mined, but recent exposures indicate organic soils overlay weathered rock. During construction of pad 6, a borrow pit was developed in the low land near highway 265 at an elevation of 400'. The existence of this deeply weathered rock at this elevation indicates that the present topography is not a result of recent erosion.

Hydrology

General Description

Drainage Patterns

The perimeter of Brewer hill is incised by numerous third order drainages in a nearly radial pattern, that feed into Little Fork Creek to the northeast, and Lynches River to the southwest.

Aquifers

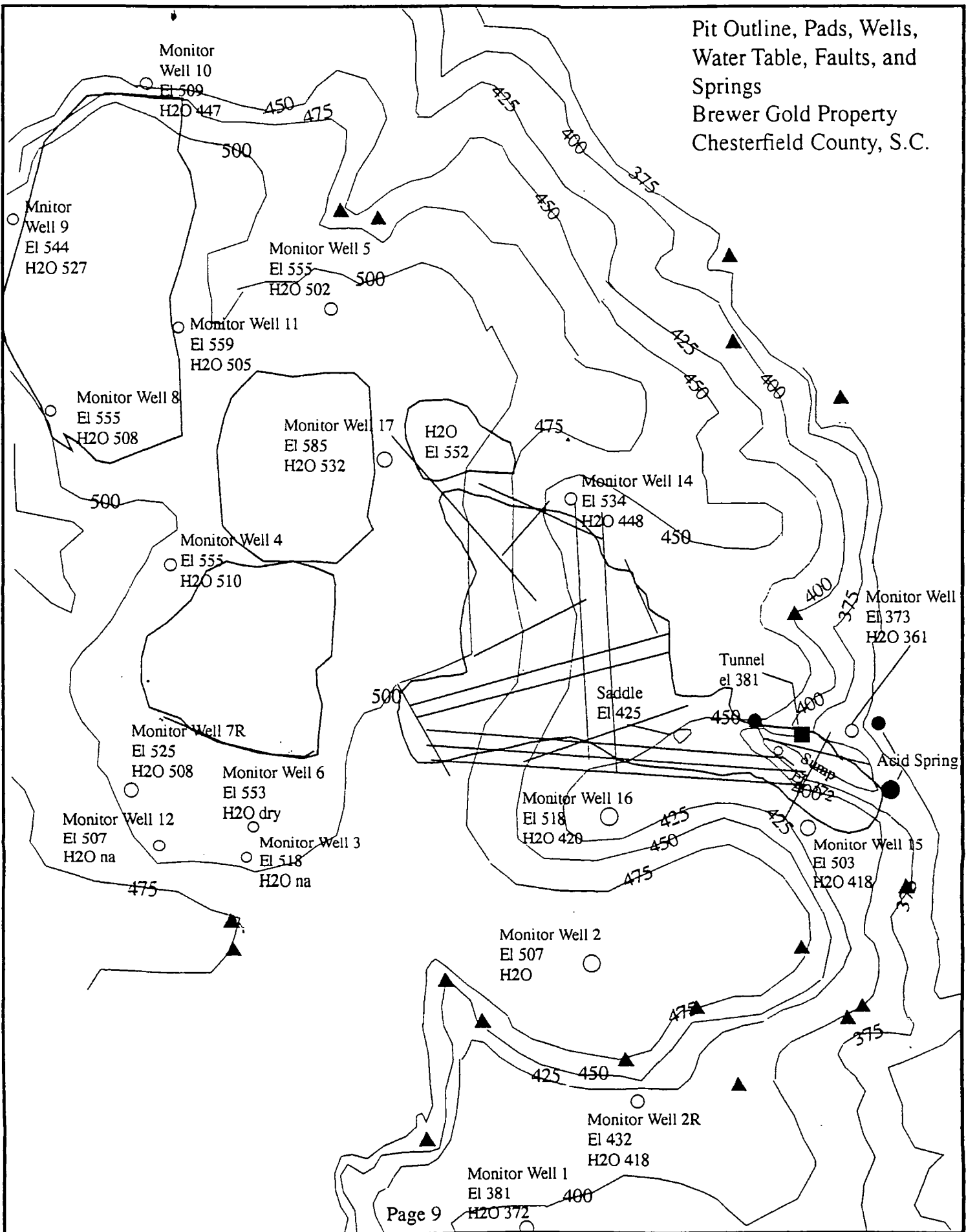
The original lithology of the Brewer Hill rocks is dominantly volcanic with very little intrinsic porosity. The present porosity of the rock is secondary and a result of either fracturing, or weathering. The resultant aquifer is an unconfined crystalline aquifer. There is no impermeable cap over the high porosity layer. At Brewer Hill, this unconfined condition restricts the maximum elevation of water from regional groundwater flow to the saddle elevation at the north; 416'.

The shape of the saturated aquifer is dependant on depth of weathering, open fractures and recharge. This results in a highly irregular lower limit of the aquifer. Transition from weathered to unweathered rocks is gradational, occurring over 10's of feet, fractures may extend the lower limit of the aquifer 100's of feet in narrow areas. The upper limit of saturated rocks is dependant on water flow into available open space. If the porosity of the aquifer is sufficiently connected, the top of the "water table" will be smooth.

Confining Units

Monitor well #3 has shown artesian flow from the time it was installed. This well was collared in the Tanyard Syncline, and terminated in either the Brewer volcanic rock, or the less sericitic Tanyard rock. Water production from the well was first encountered after penetrating a bull quartz section, interpreted to be the contact between these two rock types. The interpretation is that the steeply dipping north limb of the Tanyard Syncline involving highly sericitic lithologies is acting as a confining layer.

Pit Outline, Pads, Wells,
Water Table, Faults, and
Springs
Brewer Gold Property
Chesterfield County, S.C.



Detailed Description

Surface Drainage

A survey was made of the drainages surrounding the Brewer Hill. A description that takes the form of a traverse around the hill starting at the road to the sediment pond near the office has been placed in an appendix at the back of this report. A table listing hydrologic information follows. A map showing locations of springs is included after the table.

Historic Operations

The Brewer Gold Deposit may have been discovered as early as the 18th century. By early in the 19th century there is record of a large organized operation. Before the Civil War in the 1860's, the Brewer Drainage Tunnel had been completed, and a large milling operation established at the portal. The tunnel terminated in the pit at approximately 388' elevation with the portal at 381. Total length was approximately 1000 feet. Periodic operations were undertaken after the war resulting in a cluster of three open pits in the area of the mine. The Hilford Cut was a narrow pit north west of the Brewer Pit. The Hartman Pit lay southwest of the Brewer Pit. The Hilford with a floor elevation of 526' may have had standing water. The Hilford with a floor of 492 was dry. The Brewer with a floor elevation of 386 had standing water, and produced continuous drainage out of the tunnel.

Monitor Wells

Water level measurements have been kept for monitor wells since 1992. Of 11 wells monitored since 1992, 4 were dropped in the third 1/4 of 1997. Two wells currently monitored were installed the fourth 1/4 of 1993, and three wells were installed in second 1/4 1997. A copy of water levels for all of these wells appears with this report. The water levels of some of the wells have been graphed and appear in this report in the discussion section.

Historic Pumping Levels

Prior to mining the Brewer Pit drained approximately 50 to 100 gpm water out an existing dewatering and production tunnel at 381' elevation into the Brewer Tunnel Creek. When mining activities proceeded below the existing tunnel, water was pumped at a rate of about 100 gpm down to 330' elevation. When mining in the Brewer Pit area ceased, and activities were commenced in the B-6 pit, water was pumped from the B-6 into the Brewer. Pumping records are not available for the period that mining in the B-6 area proceeded below the level of the existing stream drainage and down to 340' elevation. A six inch diesel pump was used, and ran most of the time. Pumping rates were probably around 500 gpm. When reclamation activities commenced in August of 1995, the Brewer was flooded nearly to the tunnel floor elevation at 388 feet. In August of 1995, pumping from the Brewer was started, and the pit was dried out December of 1995 after 120 million gallons of water had been pumped.

Brewer Mine Backfill Activities

The Brewer Mine consisted of the Brewer Pit and the B-6 Pit, separated by a saddle of undisturbed rock. Mining activities had resulted in creation of waste rock, sulfidic heap tails, and non sulfidic heap tails. The waste rock and heap tails were used as material to backfill the two pits.

After backfill, an impermeable cap was installed over the backfill, and surface runoff was directed away from the area backfill activities started in January of 1996. All reclamation activities were complete in June of 1997. Backfill activities were designed to place sulfidic material either below the water table where it would be isolated from oxygenated surface waters, or well above the water table where it would be isolated from water.

Brewer Pit Backfill

The Brewer Pit, originally excavated to an elevation of 330' was backfilled to at least original surface elevation. From the deepest part of the pit, up to about 400' elevation, the pit was backfilled with acid producing heap tails. During infill of this layer, the historic drainage tunnel was plugged with cement and abandoned. This material was followed by inert non acid producing heap tail material to about 450' elevation. Within this second layer, a stone filled outlet was built: the Brewer Sub drain. The succeeding layers of the Brewer Pit Backfill, above the inert layer, were acid producing waste rock, followed by acid producing heap tails. Finally the backfill was covered with an impermeable cap.

Brewer Sub drain

This element is a stone filled channel wrapped with an impermeable layer, with a base elevation of 425'. It extends to the east over the low point of the Brewer Pit, and has an outlet above the B-6 seep, at an elevation of 380 feet. It was designed to intercept overflow waters of the Brewer Pit. It shows no flow of water.

B-6 Pit and Saddle Area

These areas were filled with acid producing waste rock, and capped with an impermeable layer. The deepest part of the B-6 Pit was filled with highly sulfidic waste rock during mining operations in the early 1990's.

Limestone Sump

Below the discharge of the Brewer drainage tunnel, a boggy area developed. It is likely this area was backfilled with waste rock from the excavation of the drainage tunnel. This material was excavated to bedrock, and backfilled with limestone. An outlet drain was plumbed and the overflow water conveyed to a pumping point.

Tunnel Seep

4. Topographically above the projected level of the drainage tunnel outlet, a seep of less than 20 gpm, was identified in the north wall of the drainage, that flowed towards the Limestone Sump area. This water was caught in a lined sump and conveyed to a pumping point.

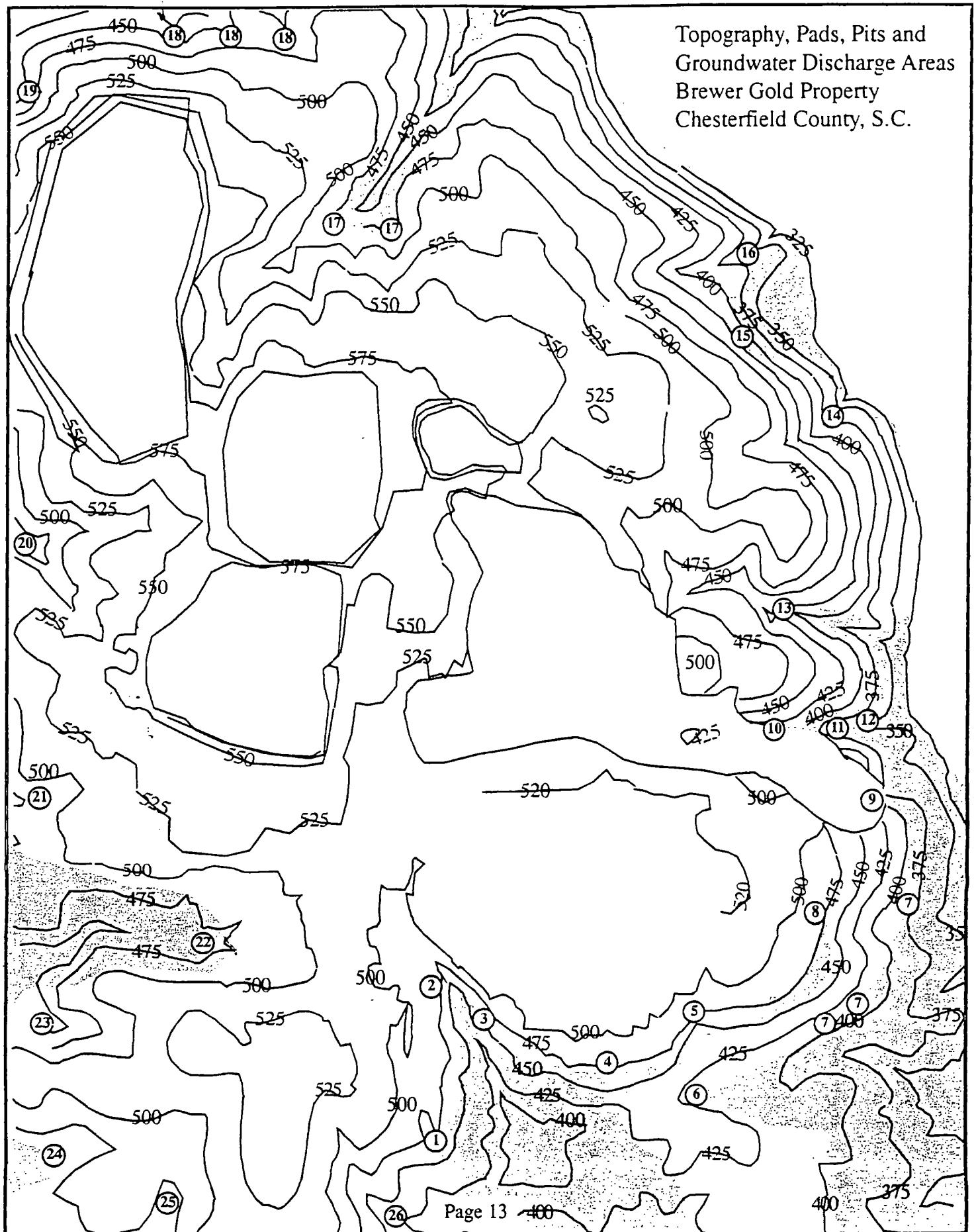
Lower Acid Spring

The waters from the Limestone Sump, and the Tunnel Seep are caught and piped to a lined sump called the Lower Acid Spring. A pump on a timer transfers this water to the main pumping tank below the B-6 seep. Production is estimated at 25 gpm.

Table 1: Summary of Water Discharge Features

Location	I.D. #	Elevation	Flow Rate & Comments	Ph
Flooded Adit	1	475'	5 gpm	4.5
West Waste Dump Drainage	2	475'	5 gpm, increases downstream	3
Roadbed Seep	3	475'	1 - 2 gpm, algae	3
South Waste Dump Seep	4	475'	1 - 2 gpm	3
East Waste Dump Seep	5	475'	1 - 2 gpm, red	3
Monitor Well 2R Seep	6	400'	2 - 5 gpm wetland	4
Outerbelt Seeps	7	400'-375'	1 gpm or less	4.5
B-6 Access Road Seep	8	475'	Less than 1gpm	4.5
B-6 Acid Spring	9	375'	100 gpm Monitored	2.8
Drainage Tunnel Seep	10	435'	Less than 1gpm visible	N.S.
Limestone Sump Seep	11	400' ?	Inaccessible for sampling	N.S.
Lower Acid Spring	12	N.A.	25 gpm (pumping point)	N.S.
One North Drainage	13	410'	5 gpm increases to 75 downstream	4.5
Two North Drainage	14	350'	5 - 10 gpm	4.7
Cane Slope Seep	15	400'	Wetland	N.S.
Three North Drainage	16	360'	1 - 2 gpm	4.7
Pad 6 Pond Drainage	17	475'	20 gpm, increases to 75 downstream	3.2 / 5
Pad 6 North Drainages	18	N.A.	Dry	N.A.
Pad 6 Northwest Drainages	19	N.A.	Not Checked	N.A.
Pad 6 Southwest	20	425'	1 - 2gpm, increases downstream	4.0
MW 7R Drainage	21	N.A.	Not Checked	N.A.
Office Drainage	22	485'	5 gpm, wetland, increases	4.5
Office One South	23	N.A.	Dry	N.A.
Tanyard Highland West	24	475'	2 - 5 gpm	4.5
Tanyard Highland S & SW	25	475'	Not Checked	N.A.
Tanyard Highland East	26	475'	Dry to 400'	N.A.

Topography, Pads, Pits and
Groundwater Discharge Areas
Brewer Gold Property
Chesterfield County, S.C.



B-6 Acid Spring

After backfill operations of the B-6 pit were complete, a seep near the low point of the pit rim developed. This flow amounts to about 100 gpm, and is caught and conveyed to a pumping station.

Pads

The pads were unloaded into the pit. Original construction of these features included building a substrate of compacted clay. This low permeability material was left in place.

Discussion

The General Character of the Brewer Hill Aquifer

From examination of the surface drainage of the area, and general hydrologic assumptions it is probable that the preexisting ground water gradient of the area is similar to the surface drainage pattern. In general the gradient is to the southeast, and radial from the upper elevations of the Hill towards the bounding stream drainages. The aquifer of the area is a crystalline aquifer with pore space that was created by weathering and structural processes. Because much of the rock in the area contains sulfides, a key component to weathering is oxidation of sulfides. Where the groundwater level has not changed recently, the acid producing sulfides have been oxidised, and water flow through the aquifer does not change the ph.

The preexisting hydrology of the area was altered by the historic excavation of the Brewer Pit and the drainage tunnel in the 19th century. The lowering of the water table by the drainage tunnel may have allowed groundwater to contact sulfidic rock in fractures, lowering the ph of the groundwater, however, the bulk of the porosity of the aquifer resides in pore space of oxidised rock. The hydrologic system was again affected by excavation of the B-6 and Brewer pits and other activities in the 1990's, and by backfill activities during mine closure. A description of the general hydrology of the area, and certain specific areas will be attempted below.

Surface Hydrology

The survey of the surface streams of the area located discharge elevations of water. These streams indicate a discharge at the elevation contour of 450 to 475 in the north, west, and south of the property. A second discharge was found at 375 to 400 in the east and south east of the property. There appears to be an overlap of these discharge zones in the southeast part of the property.

Subsurface Hydrology

The water elevations in monitor wells was plotted, along with the surface data to yield a piezometric surface map. A cone of depression is indicated around the Brewer - B-6 pit area,, though the limits of the drawdown effects of the pit cannot be absolutely established with the present distribution of wells. A discussion of some of the hydrologic features of the area follows.

Monitor Well Variation

The monitor well water levels were graphed for wells 2R, 4, 13, 14, 15, 16, and 17. Wells 2R and 4 are well away from the pit, and should act as background wells, reflecting climatic variation. Wells 14, 15, 16, and 17 surround the Brewer- B-6 pit area and may reflect groundwater effects related to mining operations. At this scale, the most notable well is MW-14. It is difficult to assign a cause to the dramatic rise in level after the second quarter of 1996. The drop in level of this well during the period when the Brewer was dewatered could be expected, but rather than return to pre dewatering conditions after backfill, it continued to rise. I can only assume that the backfill is impeding water flow through the pit, and the water table in this area is returning to pre mining conditions. None of the other holes near the pit were installed prior to backfill, so this effect cannot be confirmed.

Brewer Pit

The Brewer pit historically generated a 100 gpm discharge through the drainage tunnel at an inlet elevation of 388'. During backfill an attempt was made to plug this discharge, and establish a drain at 425'. Experience has shown the Brewer will fill to at least the drainage tunnel elevation, at 388'. The inlet elevation of the new "sub drain" is at 425', and no discharge has been detected from this feature. The saturated level of the backfilled pit should be below 425', and above 388' if the tunnel plug is functioning.

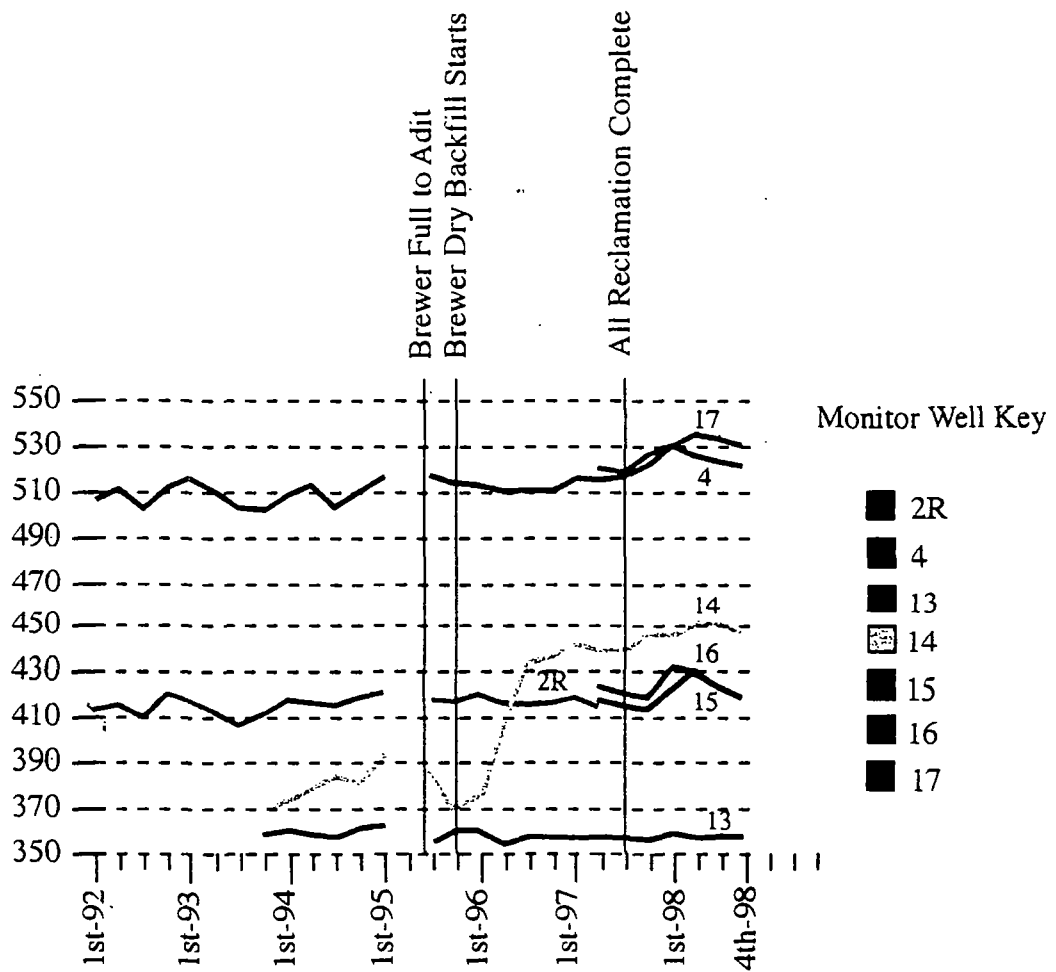
A cone of depression into the Brewer Pit is indicated by Monitor wells MW-14 to the north, MW-17 to the west and possibly, MW-16 to the south. This cone indicates discharge is occurring somewhere. The location of this outflow is not known. There is the possibility that part of the water in the one north drainage originates at the Brewer Pit. There is also the possibility that this water is being diverted to the B-6 pit in the subsurface. (see below)

B-6 Pit

The B-6 Pit was excavated south of the Brewer Tunnel Drainage into un oxidized rock. The pit intersected original topography at an elevation of about 385' below the Brewer Tunnel, and at 375' on the hillside south of the drainage. Between these two points an area of undisturbed ground rises to an elevation of 425', forming the northeast corner of the pit. Monitor well MW-13 is located on the north slope of this ground. There is now a 100 gpm discharge of water near the location of the low point in the original B-6 pit at 375'.

Monitor Wells MW-15, and MW-16 south of the pit indicate a cone of depression from 420' down to the B-6 pit. Water elevation in the pit is assumed to be controlled by the outlet elevation at 375'. South of the pit, though the water levels seen in MW-15 and MW-16, and MW-2R are similar, there are seeps in the area between the monitor wells that occur at 475' elevation, indicating a divide between 2R and wells 15, and 16. This divide occurs somewhere south of 15 and 16, under the old waste dump, and establishes the extent of the cone of depression into the B-6 pit.

Graphs of Monitor Wells Surrounding the Brewer Pit
 Brewer Gold Mine
 Chesterfield County
 South Carolina



Brewer - B-6 Linkage

When the mine was operating an unmineralized rib or saddle of rock was left between the B-6 and the Brewer. While the Brewer was excavated to an elevation of 330, and the B-6 was excavated to 340, the low point of the connection is at 425. At the lowermost levels, the pits are separated by a 500' wide rib of undisturbed rock. If the plug in the tunnel has failed, and the tunnel is flooded, there could be seepage from the tunnel south into the B-6.

The fault map shows an east west trend fault passing from the Brewer into the B-6 at the south wall of the B-6. The water flow into the B-6 was thought to occur from the south side of the pit. At the Brewer end, these faults are at an elevation above 400', (above the water) while at the B-6 end they pass through the lower levels of the pit. An intersection between the east - west faults and north south faults that cut the deeper levels of the Brewer pit is shown. The high pumping rates at the B-6 while mining imply that there was a recirculation of water.

Brewer Tunnel Drainage - Limestone Sump and Upper Seep

The original drainage was intercepted by the B-6 pit at the confluence of two forks of the creek. What remains of the south fork is a hanging valley with an upper creek elevation of about 380' at the B-6 crest. A remnant of the valley wall rises to the south to an elevation of about 425. The creek bed descends to the east to Fork Creek. There are several sources of water flow into the drainage. There is water discharge from a seep above the tunnel at an elevation of about 435'. The drainage below the tunnel was excavated and backfilled with limestone, and bedrock inflow was noted. The base elevation of this sump is not known. Monitor Well MW- 13, with a collar elevation of 373 is located south of the original creek in the undisturbed remnant of the south hillside. It shows a water elevation of 361.

Connectivity of Tunnel Creek to the B-6 Pit

Inflow from the Upper Seep on the north wall of this area is at 435, above the limits of the water level in either the B-6 pit or the Brewer Pit. The crest of the B-6 pit, at the upper end of the drainage is no more than 10' above the B-6 outflow. The basal elevation of the limestone sump in Tunnel Creek is not known, but for underflow from B-6 to occur, it would have to be below the 375' B-6 outflow elevation. The water level in MW-13 in Tunnel Creek at 361' is the best indication that the groundwater of the Tunnel Creek Drainage area is isolated from the B-6 water.

Connectivity of Tunnel Creek to the Brewer Pit

An attempt was made to plug The Brewer Drainage Tunnel during reclamation activities. Since there is not a recognizable flow into the drainage at the historic 100 gpm volume of the Brewer outflow, this plugging must have been at least partially successful.

Upper Discharge Elevation

There is a preferential discharge elevation horizon on the Brewer Hill at 450 to 475', seen in the origin of creeks in the north, west, southwest and south of the property. This may represent the effective outcrop location of the base of the weathering induced aquifer. It occurs in areas of different rock type over a wide spread area. Because of the slope of the top of Brewer Hill, it is nearly the same as a line drawn fifty feet below the top of the hill. At this elevation, there should be little or no contribution from regional groundwater flow, limited to 416' by the saddle at the north end of the property. This water should be from local recharge areas.

Lower Discharge Elevation

There is a second preferential discharge elevation horizon at an elevation of 375' to 400'. This horizon is expressed by springs or seeps in the northeast, east and southeast areas of Brewer Hill. The elevation of this discharge horizon theoretically allows a contribution from the regional groundwater flow, limited to 416 by the saddle at the north of the property, though it is well above the level of Little Fork Creek to the east, one of the bounding features.

Overlap Discharge Area

In the southeast part of the property below the old waste dump, there is an area where both of the discharge horizons are expressed. Except in the case of the seep above the road near monitor well MW-2R, these are low volume seeps identified in the borrow ditch on the uphill side of road cuts. The actual upper limit of saturated rock may occur above the point where it is first seen.

Total Available Water

An order of magnitude prediction of total groundwater available can be made for the property. The isolation of the Brewer Mine Hill from the surrounding regional aquifer limits water to that available from local recharge areas. Because there appears to be a discharge horizon near elevation 475, the recharge area is that area above this elevation, approximately 20 million square feet. If 25% of the approximately 60 inches of annual rainfall available in this area migrates to the groundwater total available groundwater would be: $\text{area} \times \text{water} / \text{minutes (per year)} = 20\text{m} \times (15/12) = \text{ft}^3 \text{ water} / 365 \times 24 \times 60 = \text{minutes} \times 7.4 \text{ gallons / ft}^3 = 355 \text{ gpm}$ This calculation is admittedly rough, but the order of magnitude prediction is that total groundwater flow from local recharge is limited to a sustained flow of less than 500 gallons per minute.

One North Drainage

The drainage immediately north of Brewer Tunnel Creek shows a flow originating at an elevation of about 415'. Because this elevation is within the predicted limits of water elevation in the Brewer Pit, it is possible subsurface discharge from the Brewer is contributing to the flow of approximately 100 gpm in this drainage.

Two North Drainage

This drainage, the second north from the Brewer Tunnel Creek drainage has a rocky creek bed indicating persistent flow over a long period of time. When this investigation was made, the drainage was dry down to the 350 elevation. My interpretation is that groundwater flow to this drainage has been intercepted by the original Brewer Pit. Though the stream bed would be swept clean by rainfall events, the water worn stream bed is a result of previous continuous flow.

Synthesis

An interpretation of the origin and paths of certain water contributing to outflows is attempted below.

B-6 Outflow

The B-6 pit was backfilled with relatively poorly compacted run of mine waste material. Because the B-6 acid spring outflow can be affected by pumping from the B-6 internal sump, it is probable that this backfill is very porous, and water travels through it with little impediment. It may almost be visualized as a lake with an outflow at the pit crestline at the B-6 acid spring.

Groundwater flows into the B-6 pit area from the south existed prior to mining and probably continue to the present. Faults near the south limit of the B-6 were mapped during mining that may form a connection to the Brewer pit, though water flow from these structures was never established. Pumping rates estimated at 500 gpm were necessary to keep the B-6 dry during mining. Because this rate of water production approaches total water available from all sources on the Brewer Mine Hill, some recirculation from the Brewer to the B-6 probably occurred.

Because the B-6 was excavated in un oxidized rock within a discharge zone, once groundwater flows into the B-6 pit it is retained, in contact with the highly sulfidic mine waste backfill, until outflow occurs at the B-6 Spring. Assuming water chemistry is affected by contact with this backfill, retention time of groundwater in the B-6 pit will affect the chemistry of this water.

Brewer Pit

Though all fill into the Brewer was compacted, this material was non plastic, and should have retained porosity. A more highly porous zone at the perimeter of the pit was intentionally established during backfill. Groundwater flow into the Brewer could be intercepted by the perimeter porous zone and conveyed around the perimeter of the pit, to the Brewer Sub drain at elevation 425, unless it is being intercepted by an outflow feature below this level.

The recovery of groundwater levels at Monitor Well MW- 14 to above pre backfill levels indicates backfill of the Brewer affected groundwater flows. The present measured level in MW- 14 is 50 feet above the level seen when the Brewer was flooded nearly to tunnel level at 388'. Prior to backfill the Brewer Pit was a lake, and the monitor well level reflected changes in pit water levels. It is suggested that backfill activities have caused the Brewer Pit to become part of the aquifer and the level in MW-14 identifies an elevated cone of depression that probably extends into the Brewer pit backfill.

It is suggested that water flowing into the backfilled Brewer Pit from the northwest may have saturated the backfill to nearly the 450' elevation of MW-14, but this saturated surface slopes to an unknown outflow below elevation 425' before the Brewer Sub drain. Outflow from the Brewer Pit may be occurring through the oxidised rock on the north wall of the pit, through faults to the B-6, through the old drainage tunnel, or a combination of the three.

Appendix 1: Outflow Areas

1.)Flooded Adit: At 475' elevation there is a water filled adit dug into residual sandy sediments. No flow was seen from this feature.

2.)West Waste Dump Drainage: At 475' elevation small seeps from bedrock are seen in a well developed drainage. Water flow increases down the drainage to a total flow of less than 25gpm.

3.)Roadbed Seep: At 475' elevation a small seep of less than 5gpm was seen in an old bench or roadbed approximately 400' east of the drainage. Moss and algae within the ponded water indicate persistence.

4.)South Waste Dump Seep: A small seep of less than 10gpm was seen at an elevation of about 475' in a ditch incised into the stripped base south of the waste dump.

5.)East Waste Dump Seep: In a preexisting drainage at the east boundary of the stripped apron below the waste dump at an elevation near 475 a seep with reddish stained water of less than 10gpm flow was seen. Flow increases gradually down stream.

6.)Monitor Well 2R Seep: In the drainage that heads up near MW-2, a seep is seen at an elevation of 400'.

7.)Outerbelt Seeps: The road between MW-2 and the B-6 area drops from an elevation of 400' to around 375', and shows at least 3 seeps where the roadbed intercepts drainages.

8.)B-6 Access Road Seep: The road from monitor well 16 to the B-6 area shows a small seep in the ditch adjacent to the road at an approximate elevation of 475'.

9.)B-6 Acid Spring: Near the lowermost point of the old B-6 pit an discharge of approximately 100 gpm is collected and piped to a tank. Elevation is 375.

10.)Tunnel Seep: In the north wall of the old adit tunnel creek, there is a small seep of less than 5gpm.

11.)Limestone Sump Seep: The bed of the old tunnel creek was excavated and backfilled with stone to form a collection point for water flow downstream from the old tunnel. This water and the Tunnel Seep are collected at a sump and pumped out.

12.) Lower Acid Spring: This is a lined pumping and collection point for the Tunnel Seep and Limestone Sump Seep. The chemistry of these waters has been altered by the limestone sump.

13.)One North Drainage: The first drainage north of the tunnel drainage originally headed up north of the Brewer Pit. Water flow from bedrock is seen at an elevation of 400'. Flow increases downstream to on the order of 100gpm.

14.)Two North Drainage: There is a well developed topographical drainage approximately 1000 feet north of the 1North Drainage. Though the bottom of the feature shows waterworn bedrock, no flow was seen until just above Little Fork Creek at 350'.

15.)Cane Slope Seep: Approximately 400' northwest of the 2nd north drainage a steep slope without clear topographic drainage features is covered in cane growth, and shows several small seeps of less than 5gpm at elevations up to at least 400'.

16.)Three North Drainage: Approximately 1000' north west of the 2nd North Drainage a well developed topographic feature shows no flow until approximately 360' elevation, just above Little Fork Creek. The bottom of this feature shows a small rocky creek bed, but no evidence of large persistent flows.

17.)Pad 6 Pond Drainage; There is a well developed topographic drainage feature that heads up above the Pad 6 Overflow Pond. Flows of up to 10 gpm were seen in two of the tributary drainages at an elevation of 475'. Flow increases steadily down stream to on the order of 100gpm at the Little Fork Creek discharge.

18.)Pad 6 North Drainages: Three small topographic drainage features may be seen due north of Pad 6. No flow was seen in these features down to an elevation of 425'.

19.)Pad 6 northwest drainages: Two topographic drainage features may be seen northwest of Pad 6. These features were not investigated.

20.)Pad 6 Southwest: Two topographic drainage features may be seen heading up in the neighborhood of Monitor Wells 8 and 4. Water was seen below the confluence of these two features at an elevation of approximately 425'.

21.)JMW 7R Drainage: A small topographic drainage feature heads up near monitor well 7R. This drainage was not investigated.

22.)Office Drainage: Water was seen in numerous old pits west of the office at an elevation of 475 to 490'. Flow increases down stream to a flow of less than 100gpm.

23.)Office Drainage One South: A tributary to the office drainage drains the Tanyard Highland south of the office. This drainage was dry.

24.)Tanyard Highland West: A topographic feature heads up in the southwest quadrant of the Tanyard Highland south of the office, and trends to the west. Water was seen at an elevation of 475'.

25.)Tanyard Highland Southwest and South. Topographic features exist draining the Tanyard Highland to the southwest and south. These features were not investigated.

26.)Tanyard Highland East: A drainage feature trends from the highland east to just below the Sediment Pond Dam. No water was seen in this feature down to 400' elevation.

Appendix 2: Brewer Monitor Well Data

Historical Monitor Well
Water Levels (msl)

1996

1997

Historical Monitor Well
Water Levels (msl)

198

MW#	1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st	2nd	3rd	4th	MW#
1	275.9	366.9	367.9	368.9	170.9	366.4	365.5	372.0	372.0	370.0	365.5	368.5	1
2R	420.3	417.3	417.3	417.3	419.8	414.8	Dropped	Dropped	Dropped	Dropped	Dropped	Dropped	2R
3													
4	514.1	511.1	512.6	512.1	517.1	516.1	516.8	522.4	531.4	528.4	523.9	522.4	4
5	504.5	505.5	502.5	502.5	505.5	506.0	501.7	506.4	518.7	508.4	504.2	499.2	5
7R	477.2	480.2	471.7	N/A	482.7	489.7	495.7	501.8	516.3	510.4	506.9	506.0	7R
8	508.5	506.5	503.5	502.5	507.5	508.0	Dropped	Dropped	Dropped	Dropped	Dropped	Dropped	8
9	490.6	490.6	483.6	483.6	489.6	492.1	Dropped	Dropped	Dropped	Dropped	Dropped	Dropped	9
10	448.5	441.5	438.5	439.5	448.5	443.0	Dropped	Dropped	Dropped	Dropped	Dropped	Dropped	10
11	508.7	507.7	506.7	506.2	Dropped	Dropped	Dropped	Dropped	Dropped	Dropped	Dropped	Dropped	11
12													
13	361.0	355.0	358.5	358.5	357.0	358.0	357.0	357.5	359.3	357.4	358.5	358.5	13
14	376.0	412.0	434.0	436.0	442.0	440.0	439.7	446.0	446.5	451.4	451.5	446.5	14
15	N/A	N/A	N/A	N/A	N/A	418.0	416.4	415.6	423.5	431.4	425.1	419.6	15
16	N/A	N/A	N/A	N/A	N/A	424.0	422.1	420.4	432.4	430.4	424.9	420.4	16
17	N/A	N/A	N/A	N/A	N/A	521.0	520.8	527.4	531.6	536.4	535.6	531.6	17

Historical Monitor Well

Water Levels (msl)

Top of Well Ref Elev.		<u>1992</u>				<u>1993</u>				MW#
MW#	(msl)	1st	2nd	3rd	4th	1st	2nd	3rd	4th	
1	380.9	368.4	368.9	363.9	368.4	371.9	364.9	359.9	362.9	1
2R	431.8	413.8	415.3	410.8	421.8	418.8	412.3	407.8	411.8	2R
3	518.0	This well is used for service water, level is not ava								3
4	555.1	508.1	512.1	504.6	512.1	516.6	511.1	503.6	503.1	4
5	555.5	499.0	512.5	492.5	499.5	503.5	502.5	495.5	495.5	5
7R	525.7	469.4	455.7	448.7	444.7	457.7	470.7	463.7	463.2	7R
8	555.5	499.0	514.5	504.5	506.5	516.5	512.0	502.5	502.5	8
9	543.6	497.1	494.6	488.6	490.6	504.6	499.6	487.6	484.6	9
10	509.5	447.9	449.5	438.5	445.0	461.5	444.5	435.5	436.0	10
11	558.7	507.1	505.7	504.2	504.2	506.7	506.7	503.7	504.7	11
12	506.7	This well is used for service water, level is not ava								12
13	373.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	359.0	13
14	534.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	370.5	14
15	503.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	15
16	518.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	16
17	585.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	17

Historical Monitor Well
Water Levels (msl)

<u>1994</u>					<u>1995</u>				MW#
MW#	1st	2nd	3rd	4th	1st	2nd	3rd	4th	
1	371.9	367.9	366.9	369.4	368.9	N/A	366.9	369.9	1
2R	418.3	416.8	415.3	419.3	421.8	N/A	417.8	418.8	2R
3						N/A			3
4	510.1	513.1	504.1	511.1	518.1	N/A	518.1	515.1	4
5	502.5	512.5	500.5	502.5	513.5	N/A	502.5	505.5	5
7R	457.7	453.7	458.7	459.7	466.7	N/A	467.7	482.7	7R
8	508.5	504.5	503.5	505.5	520.5	N/A	522.5	505.5	8
9	526.6	488.6	486.6	502.6	504.1	N/A	504.1	489.6	9
10	446.5	442.5	440.5	443.5	458.0	N/A	459.0	441.0	10
11	504.7	506.7	506.7	521.7	509.7	N/A	509.7	508.7	11
12									12
13	361.0	359.0	358.0	362.0	363.0	N/A	356.0	361.0	13
14	374.0	379.0	384.0	382.0	393.0	N/A	387.0	371.0	14
15	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	15
16	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	16
17	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	17

BREWER GOLD MINE WATER TREATMENT PROPOSAL

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Abstract – This report deals with the methods whereby Brewer Gold acid mine water may be converted to fertilizers and marketed for a profit.

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Appendix

U.S. Bureau of Mines Report RI 9200
Commercial Humates for Agriculture and Fertilizer Industry- E. M. Burdick
Brewer Gold Water Treatment Flowsheet Illustration - 500 gallons per minute
Acme Assay - See 5599-6 mine water sludge
Mid Continent Assay - mine water B-6 influent
Mid Continent Assay - mine water B-6 effluent (KM 11A)

Brewer Gold Mine Water Treatment Proposal

Introduction

In December 1998 the author visited the Brewer Gold Mine at Jefferson, South Carolina, at the request of Mr. B. G. Long, mine manager. The purpose of the visit was to investigate the possibility of providing a way to convert the negative cash flow of the current waste water mine treatment facility to a positive income. The current treatment consists of neutralizing the wastewater with $Mg(OH)_2$ (magnesium hydroxide) which produces a noncommercial waste sludge.

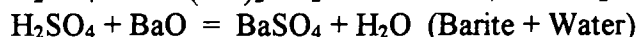
Subsequently, one barrel (55 gallons), of acid mine water was shipped from the mine to the authors test facility near Henderson, Nevada. Resulting experiments showed that by substituting fertilizer grade hydroxides for $Mg(OH)_2$ which is currently in use and adding Leonardite (a common New Mexico lignite high in humic acid content) the resultant sludge contained compounds that are commonly sold as fertilizer and or soil amendments. In addition, gold, silver and copper, report as a metallic fractions that can be separated by electrolytic and gravity separation techniques. The iron reports as a brown oxide. Further, our patented device, the Siphon Gravity Classifier Clarifier (SGCC), which operates under vacuum, also precipitates metals from basic (hydroxide) solutions. The SGCC concentrates the sludge and prepares it for passage through electrolysis. This step concentrates the metals for separation on a shaking table. The metallic minerals produce a concentrate. The iron oxides and carbon, which are lighter, become table rejects and can be recycled and rebled into the resulting sludge.

Experimental Results

Experiments with the Brewer Gold Mine water demonstrated that humates dissolved in alkaline hydroxides could be used to quantitatively precipitate the dissolved metals. Magnesium, potassium, calcium and ammonium hydroxides all work well in dissolving the humates. Depending on the hydroxide used, the resulting sludge could be made to contain compounds, such as magnesium, nitrogen, potassium, calcium and carbon that are usually sold as fertilizer and or soil amendments.

Proposed Sulfate Removal

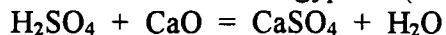
The humate-hydroxide test further showed that although 99+% of the metals were removed from the water little or none of the sulfate was removed. The sulfate may be removed by precipitation with barium hydroxide $(Ba(OH)_2 \cdot 8H_2O)$. Sulfates may also be removed by precipitation with barium oxide.



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Due to the relative insolubility of barite in water (0.00022 gm/100ml H₂O) and the solubility of barium hydroxide in weak acid or warm water, this reaction is almost quantitative. That is, it will remove 99+% of the sulfate from the water after the metal has been removed. The resulting solid product, barite, is used for many industrial applications and for drilling mud. It is also used to seal ponds.

Another method of removing the sulfate is to add slaked lime (CaO) to the acid mine water. This will remove the sulfate as gypsum (CaSO₄).



This reaction will leave about 2.5 gm/l of gypsum dissolved in the water. This is the gypsum content of most western U.S. drinking water reservoirs at this time.

Chemical Variations

There are many variations that can be used to produce a variety of marketable products from the Brewer Gold Mine Water. However, the laboratory tests showed maximum results, minimum costs with maximum yield of saleable products using ammonia and lime as the basic hydroxides. When coupled with New Mexico humates, this combination yielded two saleable byproducts, fertilizer and metals.

Fertilizers are sold for their content of N-P-K, nitrogen, phosphorus and potassium. However, in addition to N-P-K, air, sunshine and water, plants also need humic acid (carbon for carbon dioxide-CO₂), sulfur, calcium, magnesium, boron, copper, iron, manganese, molybdenum and zinc. All of the above are found in the Brewer Gold mine water sludge with the possible exception of N, which can be added by treating the water with NH₄OH (ammonium hydroxide).

Anhydrous Ammonia, Lime and Humate Addition

Metals can be removed from the mine water by the addition of hydroxides and humates and can be recovered from the low volume sludge stream produced by the SGCC. There is an expected 31 gm of sludge per gallon of water treated when using 4 gm of lime, 10 gm of NH₃ and 15 gm humate per gallon of influent. This will change the pH of the water from 2.2 to 8.5. A gallon of water contains more than 3800 gm. The ratio of sludge to water is 31:3800, roughly 1:120 or 1 gallon of sludge per minute from the influent acid mine water flow. The sludge, when pulled from the bottom of the SGCC tower, contains about 80% moisture. At the proposed 500 gallons per minute treatment, this equates to 20 gallons per minute of sludge to be fed to the electrolytic system and ultimately to be dried. The sludge, when subjected to electrolytic and gravity separation methods, yields the precious metals prior to being dried and shipped as fertilizer. As an alternative to electrolysis, the sludge can be dried, ground and tabled to produce a copper, gold, silver concentrate. The tabled rejects containing humate, iron and trace elements can then be re-dried and sold as fertilizer.

The current mine water treatment process, neutralization with $Mg(OH)_2$ treats 500 gallons per minute influent (new, raw mine water) on a five day, 40 hour per week basis. We have devised the following process to follow suit utilizing the equipment and facilities already in use and on hand at the mine with the following exceptions. Two additional pieces of equipment will be utilized in implementing the mine water to fertilizer plan.

Proposed Additions

The Kansas Grinder is a new high tech device that dries and grinds in a single pass.

The Siphon Gravity Classifier Clarifier (SGCC) is a device, patented by the author, which will separate the various fractions of slurry components.

Capital Cost of Proposed Additions (Estimate)

The Kansas Grinder	\$50,000
SGCC	\$50,000
Storage Bin	\$15,000
Engineering/Installation	\$25,000
Shaking Table	\$12,000
Total	\$152,000

Options

- 1) Bypass electrolytic unit and Kansas Grinder. Substitute filter and conventional dryer and grinder. Pass dried sludge over shaking table. Filter and dry table rejects.
- 2) Pelletize and bag the sludge.
Pelletizer \$10,000, bagging plant \$10,000, conventional dryer \$15,000, conventional grinder \$15,000. Total \$50,000 = cost of Kansas Grinder.

Proposed Steps

At this point the proposal will be to use anhydrous ammonia, slaked lime and ground humates to bring the water to pH 8+ and to precipitate the dissolved metals. This will render all the precipitates, with the exception of precious metals and copper, into a basic fertilizer. The figures previously obtained from laboratory tests will be used to make the calculations and conclusions used in the report. The following proposed steps outline the procedures, reagent costs and projected revenues inherent in this proposal to produce fertilizer and precious metals from the acid mine water.

- 1) Bring the Kansas Grinder to Brewer Gold mine site:
 - a) To grind humates (New Mexico Leonardite)
 - b) To dry and grind the Brewer Gold mine water sludge

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2) Ship humates from New Mexico to South Carolina. 15 gm per gallon equates to 1,042 tons per year. This is approximately 4 X 24-ton truckloads per month. Cost of humates \$150/ton delivered to the Brewer Gold mine site.

3) Grind humates to -100 mesh.

4) Prepare water treatment solution. Use treated mine water for mixing. Bring 50 g/m treated mine water to the mix tanks from the holding pond.

a) Add to the first tank 11lb NH₃ and 4.5 LB lime per minute. This equates to 10 gm NH₃ and 4 gm lime per gallon. NH₃ used will be 695 t/y. NH₃ is delivered in pressure tanks as anhydrous ammonia at a cost \$380/ton. Lime used will be 278 t/y. Lime cost is \$69/ton. A pH meter can be placed on the outflow of treated water. This pH meter can be electronically attached to a metering valve on the reagent feeders to meter the hydroxides to the desired pH level.

b) Add to the second tank 16lb humate per minute. Dry humate, ground to -100m will be belt or auger fed from a bin to the mix tank.

5) Add ammonia, lime and humate solution to mine water at a ratio of 1:10. 50gal of solution to 500gal of mine water per minute.

6) Brewer Gold Mine produces 120 gallons per minute acid mine water influent. The water is treated at 500 g/min, 60 min/hr, 8 hr/day, 5 day/wk, and 52 wk/yr.

7) Reagent cost of influent treated:

	Year	Month
$\text{NH}_3 - \frac{11\text{lb}}{\text{Min}} \times \frac{60\text{min}}{\text{Hour}} \times \frac{8\text{hrs}}{\text{Day}} \times \frac{5\text{ days}}{\text{Week}} \times \frac{52\text{wk}}{\text{Year}} \times \frac{\$380}{2000\text{lb}}$	\$260,832	\$21,736
$\text{Lime} - \frac{4.5\text{LB}}{\text{MIN}} \times \frac{60\text{min}}{\text{Hour}} \times \frac{8\text{hrs}}{\text{Day}} \times \frac{5\text{ days}}{\text{Week}} \times \frac{52\text{wk}}{\text{Year}} \times \frac{\$69}{2000\text{lb}}$	\$19,375	\$1,615
$\text{Humate} - \frac{16\text{lb}}{\text{Min}} \times \frac{60\text{min}}{\text{Hour}} \times \frac{8\text{hrs}}{\text{Day}} \times \frac{5\text{ day}}{\text{Week}} \times \frac{52\text{wk}}{\text{Year}} \times \frac{\$150}{2000\text{lb}}$	\$149,760	\$12,480
Total	\$429,967	\$23,351

8) Reagent cost per gallon of influent treated:

120 gal/min = 63,072,000 gal/yr.

NH₃ - \$260,832/yr / 63,072,000gal = \$0.00413546/gal

Humate - \$149,760/yr / 63,072,000gal/yr = \$0.00237443/gal

Lime - \$19,375/yr / 63,072,000gal/yr = \$0.00030719/gal

Total \$0.00681708/gal = \$6.82/1000gal

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9) The precipitates dropped averaged 31gms/gal of water treated. 31gms/gal X 63,072,000gal X # / 454gms X T / 2000lbs = 2,153 T / year

10) For a chemical cost of \$429,967 per year the yield from the treated water will be 2,153 T / year of fertilizer. Originally we added 11gms NH₃ per gallon. There are 3.8 l/gal. This equates to 10/3.8 l/g to 2.63 gm/l NH₃. NH₃ is 14/17 N. 2.63 X 14/17 = 2.17 gm/l N. The assay showed that 0.35g/l ammonia remained in the water. 0.35/2.17 = 16%. 84% of the N was absorbed by the humate and recovered. 2.17gm/l N X 3.8gm/gal X 84% = 6.93 gm/gal N. 6.93/31 = 22 % N

Economic Considerations

A) Current Brewer Gold Costs

	Month	Year
Labor – 3 laborers 1 supervisor	\$17,000	\$204,000
Maintenance	\$ 1,500	\$ 18,000
Environmental Monitoring	\$ 2,000	\$ 24,000
Power	\$ 3,500	\$ 42,000
Chemicals – Mg(OH) ₂	\$12,277	\$147,324
Laboratory Supplies	\$ 2,000	\$ 24,000
Taxes	\$1,000	\$ 12,000
Total	\$39,277	\$471,324

Under the present water treatment system, the above expenses are incurred primarily to render the acid mine water environmentally acceptable for discharge into the nearby stream. The waste product produced, the red iron sludge from the magnesium hydroxide precipitates, at this time has no economic value. In fact, it may have a negative value due to it's future cost of disposal, provided no economic use can be found for the 1,000 or so tons of sludge produced per year.

The following costs are expected to produce fertilizers and metals that can be marketed through existing channels of commerce.

B) Proposed Brewer Gold Costs	Month	Year
Labor – 3 laborers 1 supervisor	\$17,000	\$204,000
Maintenance	\$ 2,500	\$ 30,000
Environmental Monitoring	\$ 2,000	\$ 24,000
Power	\$ 3,500	\$ 42,000
Chemicals NH ₃ , CaO, Humate	\$35,833	\$430,000
Laboratory Supplies	\$ 2,000	\$ 24,000
Taxes	\$ 1,000	\$ 12,000
Total	\$63,833	\$766,000

Laboratory tests indicate there will be 31 gm of fertilizer and 1 gm of precious metal, with copper, concentrates recovered per gallon as sludge from the Brewer Gold Mine Water Treatment.

The 31 gm of fertilizer will amount to 2,153 tons/yr. containing:

48% Humate
 22% Nitrogen
 8% Gypsum
 12% Metals – iron, manganese, copper, magnesium, calcium, etc.
 all of which are essential to plant growth.

Tests showed the metal content of the mine water sludge to be:

Gold	– 4 grams per ton X \$8.68 per gram	= \$34.72 per ton
Silver	– 18.4 grams per ton X \$0.16 per gram	= \$ 2.95 per ton
Copper	– 24 lbs. Per ton X \$0.70 per pound	= \$16.80 per ton
Total		\$54.50 per ton

These metals will be produced as a high grade, 100 to 1 concentrate, worth about \$5,000 per ton. There will be 27 tons of this material per year. 27 tons X \$5,000 per ton = \$135,000 per year.

Projected Revenues

A 22% N humate based fertilizer with iron and trace elements should bring \$400 per ton bulk and \$500 per ton bagged on the open market. Farmers should be happy to use this product for it will definitely upgrade the quality of their fertilizer mixes. The

humates, plus the trace elements, will prove to be highly beneficial to all that apply this material. For certain applications, potassium and phosphorus compounds, may be added to make this fertilizer a balanced, holistic plant mix. Holistic fertilizers have the capacity to cure ailing plants and soils.

2,156 tons/yr. X \$400 = \$861,200 income from fertilizer
27 tons/yr. X \$5,000 = \$135,000 income from metals
Total \$996,200 per year gross revenues for an expense of \$766,000
Net profit per year = \$230,200

Barite sales may increase the cash revenues.

Conclusion

Research by the U.S. Bureau of Mines and others has shown that humates are effective in removing 99% of the heavy metals from acid mine water. Humates proved to be effective in removing the metals from the Brewer Gold mine water. In addition, by using anhydrous ammonia and lime, along with the humates, a 22% nitrogen based fertilizer containing humates and trace elements was produced. This material can be marketed profitably as a fertilizer.

Respectfully submitted,


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REPORT OF INVESTIGATIONS/1988

Use of Lignochemicals and Humic Acids To Remove Heavy Metals From Process Waste Streams

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**UNITED STATES DEPARTMENT OF THE INTERIOR
Donald Paul Hodel, Secretary**

**BUREAU OF MINES
T S Ary, Director**

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USE OF LIGNOCHEMICALS AND HUMIC ACIDS TO REMOVE HEAVY METALS FROM PROCESS WASTE STREAMS

By John E. Pahlman¹ and Sanaa E. Khalafalla¹

ABSTRACT

The Bureau of Mines investigated the feasibility of removing heavy metals from mineral-process waste streams by precipitation with lignochemicals and humic acids. Lignochemicals are byproducts from the paper industry, while humic acids are obtained by caustic treatment of peat, subbituminous coal, and lignite. These high-molecular-weight organic materials have many functional groups, which can coordinate and form innercomplex salts with heavy metals that are crystalline precipitates.

Filtering of a humic-acid- or lignochemical-treated solution or waste stream containing these precipitates removes the heavy metal sequestrates. Tests were conducted with two lignochemical samples, three humic acid samples, lime (CaO), and sodium hydroxide (NaOH) in which increasing amounts of these additives were reacted with 50 mL of solution containing Fe^{3+} , Al^{3+} , Cr^{3+} , Pb^{2+} , Cu^{2+} , Cd^{2+} , Zn^{2+} , Co^{2+} , Ni^{2+} , Mn^{2+} , and Hg^{1+} . At the appropriate pH, greater than 90- and 99-pct removal was achieved for these 11 heavy metal ions from the 10- and 100-ppm solutions, respectively, using lignochemicals and humic acids. Removal efficiency with these organic materials is better than that with CaO, especially for the more toxic ions, Hg^{1+} , Cd^{2+} , and Pb^{2+} . Unlike the precipitates formed with NaOH or CaO, those with lignochemicals and humic acids are compact and noncolloidal. The volume of their sludge is sharply lower than that of the finely dispersed lime or soda precipitates; thus, their removal in settling tanks or by simple filtration is enhanced.

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EXPERIMENTAL PROCEDURE

Various volumes or weights of humic acids, lignochemicals, NaOH, or CaO were stirred with 50 mL of heavy-metal containing solutions for 5 min. The solution pH was determined with a pH meter for each test. After 5 min of reaction the filtrate was removed and analyzed for residual ions. H-L and CaO were added as solids, while Na-L, NaOH, and the humic acids were added as liquids.

Tests with mixed lignite and subbituminous coal humic acid solutions involved pipetting out a desired volume of

these solutions, while the residual lignite and coal particles of the stock solution were kept in suspension. Tests with unmixed lignite and subbituminous coal humic acid solutions involved pipetting out the desired volume of humic acid solution after the residual lignite and coal particles had settled to the bottom of the stock solution container. All humic acid solutions had a pH of around 11.5.

RESULTS AND DISCUSSION

100-PPM SOLUTION

Since in lignochemicals and humic acids there is one nonequilibrium exchangeable hydrogen per coordination site, the pH titration curves (figs. 1-2), demonstrate the presence of more than one coordination site in these materials. The variation of pH with the volume of Na-L added to the 100-ppm solution indicates the presence of at least three sites for metal coordination (fig. 1). Constant volume of Na-L (10 mL) is required between the successive inflection points in this stepwise titration. The molecule of Na-L appears, therefore, to be polydentate,

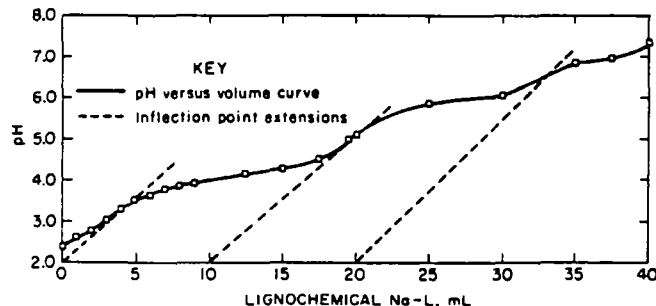


Figure 1.—pH change as function of Na-L addition to 100-ppm solution.

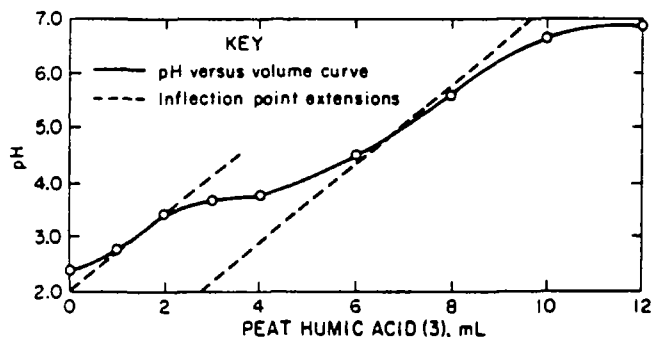


Figure 2.—pH change as function of peat humic acid 3 addition to 100-ppm solution.

capable of chelation with heavy metal ions. Similar results are portrayed in titrations with a peat humic acid where two inflection points are discernible (fig. 2).

When the metal chelate is neutral, it belongs to the inner complex salt category (2) and may be extracted by various organic solvents, or it may merely precipitate from solution. The equilibrium involving the formation of such chelates indicates a competition between the metal and hydrogen ions (or sodium ions in case of the alkali solubilized chelating agent). Hence, the more stable the chelate, the lower the pH at which it is capable of existing, and being precipitated or extracted from aqueous solutions. This pH effect has been utilized to compare the relative stabilities of various metal chelates with a given ligand. Thus the pH's of incipient precipitation (50 pct precipitation), or 99 pct precipitation can be taken as a measure of metal removal efficiency with these polydentate chelating reagents.

Figures 3 and 4 show the efficiency of mixed lignite humic acid 1 and CaO, respectively, in removing the 11 heavy metals from the 100-ppm solution as a function of pH. Table 1 lists the pH values at which 99 pct of the respective heavy metals were removed (pH_{99}) for humic acids 1, 2, and 3, CaO, and lignochemical Na-L. The order of heavy metal ions with respect to ease of their removal by humic acid 1 is Hg^{1+} , Fe^{3+} , Al^{3+} , Cr^{3+} , Pb^{2+} , Cu^{2+} , Zn^{2+} , Cd^{2+} , Ni^{2+} , Co^{2+} , and Mn^{2+} (fig. 3). This order is also followed by humic acids 2 and 3 as well as lignochemical Na-L, except that Hg^{1+} falls between Cu^{2+} and Zn^{2+} in the order of removal. The order of removal of heavy metals with lime (fig. 4) is Al^{3+} , Cr^{3+} , Fe^{3+} , Cu^{2+} , Zn^{2+} , Pb^{2+} , Ni^{2+} , Co^{2+} , Mn^{2+} , Cd^{2+} , and Hg^{1+} . The obvious differences between lime and humic acids are apparent for Fe^{3+} , Pb^{2+} , Hg^{1+} , and Cd^{2+} .

Mixed lignite humic acid 1 is superior to CaO in removal of all 11 heavy metals, as shown in figures 3 and 4, and by comparing pH_{99} values in table 1. Comparison of pH_{99} values for humic acids 2 and 3 to those for CaO shows that mixed subbituminous coal humic acid 2 is comparable or superior to CaO addition for removal of all metal ions except Cu^{2+} , while peat humic acid 3 is comparable or superior to CaO only for Hg^{1+} , Fe^{3+} , Pb^{2+} ,

TABLE 1. - pH values at which 99 pct of heavy metals were removed from 100-ppm solution

(Values in parentheses are extrapolated values)

Heavy metal ion	Humic acid		Unmixed	Lignochemical Na-L	CaO
	Mixed	2			
Hg ¹⁺	3.9	4.2	4.3	(7.5)	11.5
Fe ³⁺	4.1	4.5	4.5	4.9	4.8
Al ³⁺	4.4	4.8	4.9	5.4	4.7
Cr ³⁺	4.7	4.7	5.0	6.4	4.8
Pb ²⁺	5.2	5.9	5.3	5.5	7.3
Cu ²⁺	5.5	6.1	6.5	(7.5)	5.6
Zn ²⁺	6.9	6.9	7.3	(7.5)	7.3
Cd ²⁺	7.0	8.0	7.8	(8.1)	9.3
Ni ²⁺	7.5	8.0	(8.2)	(9.5)	8.0
Co ²⁺	7.6	8.0	(8.2)	(9.5)	8.0
Mn ²⁺	7.8	8.0	(8.5)	(10.5)	8.6

Zn²⁺, Cd²⁺, and Mn²⁺ removal. CaO is slightly better than humic acid 3 in the removal of Ni²⁺, Co²⁺, Cr³⁺, Al³⁺, and Cu²⁺. Of the reagents tested mixed lignite humic acid 1 is the best for heavy metal removal, followed by mixed subbituminous coal humic acid 2 and then peat humic acid 3.

One advantage of using humic acids is that they greatly surpass CaO in the removal of Cd²⁺, Hg¹⁺, and Pb²⁺. This is of particular importance because these metals are among the most toxic heavy metals and their removal by CaO is incomplete, especially at near neutral pH (6-8). The three humic acids have an affinity for these toxic ions; therefore, their addition to waste streams containing them is a promising way for effecting almost total removal of these ions from the waste streams.

Lignochemical Na-L is also better than CaO in the removal of Cd²⁺, Pb²⁺, and Hg¹⁺. A disadvantage of this reagent, however, is the partial solubilization of Na-L and its sequestrates above pH 7. This makes filtering difficult and reduces the degree of metal ion removal. With Na-L treatment at a pH of 7.5, Hg¹⁺, Fe³⁺, Al³⁺, Cr³⁺, and Pb²⁺ were essentially completely removed (<0.1 ppm), while Cu²⁺, Zn²⁺, Cd²⁺, Co²⁺, Ni²⁺, and Mn²⁺ were 98, 97, 90, 73, 73, and 62 pct removed, respectively. The filtered solution was light brown owing to the partially solubilized Na-L and its sequestrates. Adding 2 g of carbon black adsorbed the organics, cleared the solution, and made the filtration easier. Also, the cleared filtrate contained <0.1 ppm Cu²⁺, Zn²⁺, Cd²⁺, Co²⁺, Ni²⁺, and Mn²⁺. Carbon black addition is useful in enhancing the removal of heavy metals with respect to Na-L alone at pH >7.

Reagent H-L also removes heavy metals from solutions; however, because it remains as a solid powder in solution, only the surface functional groups of this reagent can react with the heavy metals. Its capacity for heavy metals per weight added is therefore limited. Adding 10 g of H-L to 50 mL of the 100-ppm solution removed 98, 96, 92, 90, 67, 57, 51, 44, 31, 29, and 18 pct of the Fe³⁺, Pb²⁺, Cu²⁺, Hg¹⁺, Al³⁺, Zn²⁺, Cd²⁺, Cr³⁺, Ni²⁺, Co²⁺, and Mn²⁺ ions, respectively.

Although using NaOH for hydrous oxide precipitation was slightly better than CaO addition for Cd²⁺, Pb²⁺, and Hg¹⁺ removal, it still was incomplete at near-neutral pH.

In general, removal of the other heavy metals by NaOH precipitation was not as good as by CaO precipitation at pH below 7.5. Above pH 7.5, NaOH precipitation was slightly better than CaO precipitation. Both the NaOH and CaO precipitates were gelatinous and voluminous, compared to the humic acid and lignochemical precipitates.

Results of tests with mixed and unmixed lignite humic acid 1 are shown in figure 5 for Pb²⁺, Zn²⁺, and Mn²⁺ to illustrate the part residual lignite particles (after humic acid solubilization) take in the removal of heavy metals. Comparison of these curves show that the residual lignite particles do help remove the heavy metals. For example, with 6- and 8-mL additions of the reagent, 47 and 19 pct more Pb is removed by the mixed solution; for 8- and 12-mL additions, 66 and 39 pct more Zn is removed; and for 12- and 14-mL additions, 61 and 52 pct more Mn is removed. Similar differences were obtained for the other eight ions with mixed and unmixed lignite humic acid 1 and for all 11 ions with mixed and unmixed subbituminous coal humic acid 2. Additions of either minus 200-mesh lignite, or subbituminous coal (1 g), without humic acid solubilization removed very little of the heavy metals. Another advantage of these mixed solutions is that

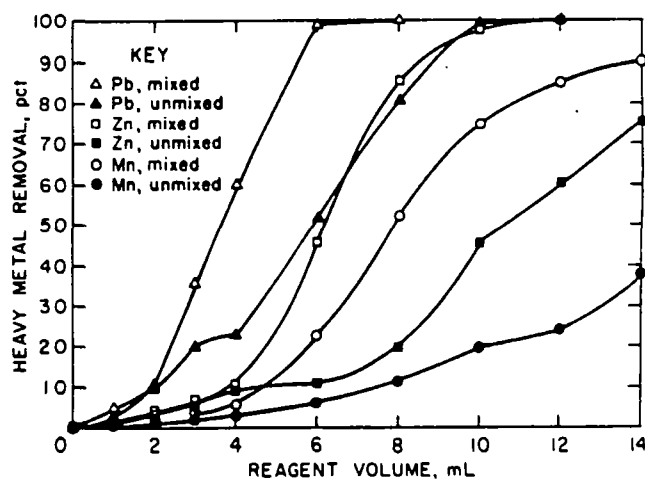


Figure 5.—Results of heavy metals removal with mixed and unmixed lignite humic acid 1 for Pb, Zn, and Mn.

respectively. With lignochemical Na-L, 3.1 and 2.8 ppm Mo (52 and 47 pct) were removed at pH's of 3.4 and 4.7, respectively. With lignochemical H-L, 3.2, 4.5, >5.0, and 4.9 ppm Mo (53, 74, >83, and 82 pct) were removed at pH's of 3.1, 3.4, 3.9, and 4.2, respectively. Very little removal was observed for any other ions in these cases.

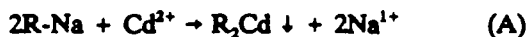
ADVANTAGES OF HUMIC ACIDS AND LIGNOCHEMICALS OVER LIME

Humic acids and lignochemicals for the most part are superior to CaO for removing heavy metals in the pH range 4.0 to 8.0. They are especially excellent in the removal of the toxic metals, Cd, Hg, and Pb, for which CaO addition is poor to fair in removing.

The precipitates formed between heavy metals ions and either humic acids or lignochemicals are compact and noncolloidal. The volume of their sludge is sharply reduced in comparison to that of finely dispersed CaO precipitates, thereby enhancing their removal by either simple filtration or settling. Lignochemical H-L sequestrates are easier to filter because they are powders.

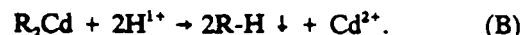
Although not in the scope of this investigation, it should be possible to recover the metal values sequestered in the humic acids and lignochemicals if desired, in a concentrated form. Since sequestering involves cation-exchange sites, it should be possible to elute them from the precipitates with an appropriate acid.

A typical reaction for precipitating heavy metals with humic acid or lignochemical is



where R is a functional group of the humic acid or lignochemical and R-Na is the sodium salt of that

functional group. Elution of the heavy metal should occur by a reaction such as



Regeneration of the sodium form of the lignochemical or humic acid is possible by addition of sodium hydroxide



Alternatively, if it is not possible or desirable to elute the heavy metals and regenerate the humic acid or lignochemical, the dried, metal sequestrates can be combusted for process heat, since the humic acids and lignochemicals are organic molecules. The heavy metals would be concentrated in the combustion ash for recovery or disposal.

The problems of voluminous amount of sludge, that are hazardous and costly to dispose, and the loss of the metals are solved with lignochemical or humic acid precipitation, followed by either elution and regeneration of the sodium form of the organic molecule, or by combustion of dried precipitates.

With humic acids and lignochemicals anionic forms of heavy metals can be successfully removed at pH 2 to 4. This is not possible with CaO addition.

SUMMARY AND CONCLUSIONS

Humic acids of lignite, subbituminous coal and peat, as well as the sodium or hydrogen forms of lignin can be employed to remove heavy metals from waste streams. Humic acids of lignite and subbituminous coal with suspended, residual coal particles are far superior to CaO addition as a means of heavy metal removal from waste streams, especially at the 10-ppm level. The sodium form of lignin and peat humic acids are comparable or superior to CaO for heavy-metal removal.

The sodium salt of lignin and the humic acids of peat, lignite, and subbituminous coal are excellent for removing the more toxic heavy metal ions, Cd^{2+} , Pb^{2+} , and Hg^{1+} , while CaO addition is poor to fair for their removal. The solubility of the heavy metal sequestrates of the lignin sodium salt at pH 7 makes removal less efficient and

causes difficulty in filtration. This can be circumvented by removing the metals with a combination of the lignochemical and carbon black. The hydrogen form of lignochemical can be employed to remove dilute solutions of heavy metals.

Addition of humic acids of lignite and subbituminous coal to process and mine waste streams resulted in almost complete removal of the heavy metal cations in the pH range 6.5 to 9.5. Efficient removal of molybdenum anions was accomplished with the hydrogen form of lignin at pH below 4.

Precipitates formed by lignochemical and humic acid addition are compact and noncolloidal. The volume of sludge is sharply reduced in comparison to that of the finely dispersed CaO precipitates.

respectively. With lignochemical Na-L, 3.1 and 2.8 ppm Mo (52 and 47 pct) were removed at pH's of 3.4 and 4.7, respectively. With lignochemical H-L, 3.2, 4.5, >5.0, and 4.9 ppm Mo (53, 74, >83, and 82 pct) were removed at pH's of 3.1, 3.4, 3.9, and 4.2, respectively. Very little removal was observed for any other ions in these cases.

ADVANTAGES OF HUMIC ACIDS AND LIGNOCHEMICALS OVER LIME

Humic acids and lignochemicals for the most part are superior to CaO for removing heavy metals in the pH range 4.0 to 8.0. They are especially excellent in the removal of the toxic metals, Cd, Hg, and Pb, for which CaO addition is poor to fair in removing.

The precipitates formed between heavy metals ions and either humic acids or lignochemicals are compact and noncolloidal. The volume of their sludge is sharply reduced in comparison to that of finely dispersed CaO precipitates, thereby enhancing their removal by either simple filtration or settling. Lignochemical H-L sequestrates are easier to filter because they are powders.

Although not in the scope of this investigation, it should be possible to recover the metal values sequestered in the humic acids and lignochemicals if desired, in a concentrated form. Since sequestering involves cation-exchange sites, it should be possible to elute them from the precipitates with an appropriate acid.

A typical reaction for precipitating heavy metals with humic acid or lignochemical is



where R is a functional group of the humic acid or lignochemical and R-Na is the sodium salt of that

functional group. Elution of the heavy metal should occur by a reaction such as



Regeneration of the sodium form of the lignochemical or humic acid is possible by addition of sodium hydroxide



Alternatively, if it is not possible or desirable to elute the heavy metals and regenerate the humic acid or lignochemical, the dried, metal sequestrates can be combusted for process heat, since the humic acids and lignochemicals are organic molecules. The heavy metals would be concentrated in the combustion ash for recovery or disposal.

The problems of voluminous amount of sludge, that are hazardous and costly to dispose, and the loss of the metals are solved with lignochemical or humic acid precipitation, followed by either elution and regeneration of the sodium form of the organic molecule, or by combustion of dried precipitates.

With humic acids and lignochemicals anionic forms of heavy metals can be successfully removed at pH 2 to 4. This is not possible with CaO addition.

SUMMARY AND CONCLUSIONS

Humic acids of lignite, subbituminous coal and peat, as well as the sodium or hydrogen forms of lignin can be employed to remove heavy metals from waste streams. Humic acids of lignite and subbituminous coal with suspended, residual coal particles are far superior to CaO addition as a means of heavy metal removal from waste streams, especially at the 10-ppm level. The sodium form of lignin and peat humic acids are comparable or superior to CaO for heavy-metal removal.

The sodium salt of lignin and the humic acids of peat, lignite, and subbituminous coal are excellent for removing the more toxic heavy metal ions, Cd^{2+} , Pb^{2+} , and Hg^{1+} , while CaO addition is poor to fair for their removal. The solubility of the heavy metal sequestrates of the lignin sodium salt at pH 7 makes removal less efficient and

causes difficulty in filtration. This can be circumvented by removing the metals with a combination of the lignochemical and carbon black. The hydrogen form of lignochemical can be employed to remove dilute solutions of heavy metals.

Addition of humic acids of lignite and subbituminous coal to process and mine waste streams resulted in almost complete removal of the heavy metal cations in the pH range 6.5 to 9.5. Efficient removal of molybdenum anions was accomplished with the hydrogen form of lignin at pH below 4.

Precipitates formed by lignochemical and humic acid addition are compact and noncolloidal. The volume of sludge is sharply reduced in comparison to that of the finely dispersed CaO precipitates.

REFERENCES

1. Broadbent, F., and T. Lewis. Soil Organic Matter-Metal Complex; Nature and Properties of Exchange Sites. *Soil Sci.*, v. 91, 1961, pp. 393-399.
2. Martell, A. E., and M. Calvin. Chemistry of the Metal Chelate Compounds. Prentice Hall, 1952, 119 pp.
3. Rashid, M. Role of Humic Acids of Marine Origin and Their Different Molecular Weight Fractions in Complexing Di- and Tri-Valent Metals. *Soil Sci.*, v. 111, 1971, pp. 298-306.
4. Schatz, A., V. Schatz, E. Schalschu, and J. Martin. Soil Organic Matter as a Natural Chelating Material. *Compost Sci.*, v. 4, 1964, pp. 25-28.
5. Schnitzer, M., and S. Khan. Humic Substances in the Environment. Marcel Dekker, 1972, 327 pp.
6. Stevenson, F. Binding of Metal Ions by Humic Acids. Ch. in *Environmental Biogeochemistry*, ed. by J. Nriagu. Ann Arbor Sci., 1976, pp. 519-541.

Commercial Humates for Agriculture and the Fertilizer Industry

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The humate content of soils must be maintained for optimum productivity. Skilled agriculturists are aware of this and accomplish it by indirect and costly methods. The same can be achieved through the use of humate concentrates, which are salts of the humic acids obtainable from natural sources, that can be added directly to soils along with regular commercial fertilizers.

Introduction

The humates are so important in garden and crop production that practically all modern soil management practices are designed to increase their content. The necessity of maintaining an adequate concentration of humate material in productive soils has been recognized by agriculturists for many years. As far back as 1786, Achard (1) conducted and published research on humus. Sprengel (50) showed it could be extracted from soil in 1826, but little or nothing of significance along this line was added during the next 100 years.

The fertilizer industry has long emphasized the importance of maintaining the humic content of soils to ensure good productivity (40). Extension and research agronomists have engaged in the study of these humic substances for many years, and many scientific data regarding them are common knowledge to most agricultural workers. Humus is the Latin word for soil. Humus and its related chemical derivatives are mainly responsible for the brown or black color of fertile soil. Humic materials are the partly decayed and otherwise transformed organic matter built up or accumulated in soils through natural biochemical processes over the ages and which convert mineral dusts into soils. Humic matter is continuously being formed in soils, and at the same time it is continuously being destroyed (33). Modern cultivation practices greatly accelerate the rate of destruction of humic material, which must be replaced in some manner if the productivity of the soil is to be maintained.

Crop rotation, adequate fertilization, planting legumes, plowing under of green manures, application of animal manures, inoculation with microorganisms and the use of expensive organic fertilizers are some of the more acceptable ways of maintaining adequate amounts of humic materials in soils. These practices are quite effective, but

they are indirect, time consuming, wasteful and costly. Simple analysis of this situation suggests that the humates be added directly to the soil exactly as is done with fertilizers. The obvious difficulty with this suggestion lies in the fact that adequate supplies of highly concentrated and purified humates are relatively unavailable commercially. Humates have been produced commercially in Austria and Japan for some time and in the United States for use in oil well drilling muds for several years (6, 11, 12), but only recently have suitable ones become available for the agricultural industry. Production is somewhat limited at present, although it is expected to increase rapidly, since various salts of the humic acids, such as the ammonium humates and the potassium humates, can be added to standard commercial fertilizer formulas to make them more complete. Recent developments along these lines in this country should soon make the humates available in large volume and at costs low enough to permit their direct application to farmlands (5).

Unique Properties of the Humates

Humus is the organic matter of soils that has decayed sufficiently to have lost its identity with regards to its origin. The most important and biochemically active group of the many degradation products of soil organic materials is the alkali-soluble fraction commonly called the humic acids. The salts of these humic acids are known as the humates. Humates supply growing plants with food, but they serve in much more important ways to make soils more productive and farming more profitable. They increase the water holding capacity of soils (40, 61), and thus soils containing relatively large amounts of humate material resist droughts more effectively and produce better yields where rainfall or irrigation may be insufficient. They improve the tilth or workability of the soil (52, 19) and thus heavy clay soils can be worked into satisfactory seedbeds and marginal soils into profitable ones. Soils are more friable and suitably sized particles are formed in the aggregate (52). They reduce soil erosion. They retain water soluble inorganic fertilizers (32, 42) and release them to the growing plants as needed. For these reasons alone, it is easy to understand why the humic acids have been so extensively studied by soil scientists and the technical literature is replete with references to the unique properties of these materials so widespread in nature.

The chemical structure of the humic acids is not definitely known, in spite of the great amount of research and study on them and their biochemical effects. It is extremely interesting that so little is really known about the chemical structure of these very important natural chemicals, which are as fundamental and necessary to man's existence as the chlorophylls. In 1938, Waksman thoroughly reviewed the literature in his book on the origin, chemical composition and importance of these materials (61), but only minor reviews have appeared since (7, 13).

In general, the humic acids have been shown to possess fairly high molecular weights and to be polymeric polyhydroxy acids derived from celluloses, lignins and proteins (30, 31, 61). They form water soluble or dispersible colloids with ammonium, sodium and potassium hydroxides, but calcium, aluminum and iron salts are quite insoluble. Various humic fractions are often classified according to their carbon to

nitrogen ratios (61). These ratios indicate somewhat the degree of humification and are influenced by the particular biochemical processes involved in their formation; for example, the ratio averages about 10 to 1 in the more humid regions of the world and considerably higher in the semi-arid regions, but rarely exceeds 14 to 1 (54, 61). Fractionation of the humic acids can be effected by the use of various solvents (44), distribution between immiscible solvents (26), chromatographic techniques (14, 17, 41), fractional precipitation (2, 3) and electrophoresis (8). Spectrographic (15) and electron paramagnetic resonance studies (57) have yielded considerable information regarding chemical structure.

Viscosity and specific gravity changes can be effected in soils through the addition of small amounts of the humates (12, 19, 23, 52). This is especially true of clayey soils. Colloidal properties and surface tension effects are readily observed in dilute solutions, which practically defy filtration and in more concentrated ones which form thixotropic gels. The ability of the humates to poise or regulate the water-holding capacity or content is probably their most significant property so far as agriculture is concerned (24), since from a quantitative point water is the most important plant material derived from the soil. In conjunction with this water regulating effect, the humates possess extremely high ion-exchange capacities (21, 27, 29, 32, 42, 45) and it is this property that makes possible better retention and utilization of fertilizers by preventing excessive leaching away from the root zones and ultimately releasing them to the growing plants as needed. The humates reduce soil erosion by increasing the cohesive forces of the very fine soil particles (61). The desirable friable character of fertile soils is maintained through the formation of colloidal mineral complexes, which assist in serratation and the prevention of large clods and stratification.

Very low concentrations of purified humates have been shown to stimulate seed germination and viability (16, 60), root respiration and formation (16), root growth, especially lengthwise (4, 16, 37, 38, 47, 48). Significant increased yields have been reported for many crops, such as cotton, potatoes, wheat, tomatoes, mustard and nursery stock (23, 24, 25, 34, 35, 39, 49, 51, 55, 56). They have also been shown to stimulate growth and proliferation of desirable soil microorganisms (20, 59) as well as algae and yeasts (9, 22, 28). A number of workers have reported that the humic acids can solubilize and make available to plants certain materials that are otherwise unavailable, such as the rock phosphates (21, 29, 58). The humates seem to play an important role in plant utilization and metabolism of the phosphates (25, 27, 53). The humic acids apparently can liberate carbon dioxide from soil calcium carbonates and this make it available to the plant through the roots for photosynthesis. The humates are known to stimulate plant enzymes (25).

The preceding list is impressive, but by no means complete. It does make it easy to understand why soil scientists, chemists and others have tried in vain to produce materials possessing similar properties. As a result, several "synthetics" have been produced, marketed and used with some success. Some of these materials have been produced by drastic degradation of natural carbohydrates and proteins, but most have been polymers of such things as vinyl acetate and maleic acid, polyvinyl alcohol,

hydrolyzed polyacrylonitrile, carboxymethylcellulose, polyacrylates, isopropyl acrylamide plus acrylic or maleic acid and poly-quaternary ammonium compounds (10, 18, 36, 43, 46). Some of these synthetics have proven to be quite effective under certain conditions, but their high cost and other limitations, such as loss of effectiveness upon drying, ageing, exposure to the elements and often stabilize the soil to much (36). The humates, on the other hand, are nature's soil conditioners "par-excellence".

Commercial Humates

Why haven't the agricultural and fertilizer industries developed the humates commercially? This question is not easily answered, especially, in view of the apparently recognized importance of the humates to both, and more so, since the market potential is so great. More baffling is the fact that high purity humic acids and humate concentrates have remained as laboratory curiosities for so long. The successful production and marketing of any chemical depends upon an economical and practical manufacturing process. A number of suitable methods for recovering the humic acids have been available for some time, so this has presented no serious problem. However, suitable raw materials such as the peats, peat mosses, mucks, forest soils, brown coals and certain lignites generally do not contain high enough concentrations of the humates to make them attractive for commercial production, but suitable sources in the United States are now known to have commercial possibilities. These include certain deposits in Arkansas, Arizona, Florida, Louisiana, New York, North Dakota, Michigan, Minnesota, Texas and Wyoming. Rich deposits exist also in Mexico. The organic-mineral soil called "aquja" found in the Big Bend area of Texas appears to be most promising and although these extensive deposits have been surveyed and studied by competent geologists, they have not been classified and named scientifically. In many areas these deposits contain over 50% organic matter, two-thirds or more of which is readily recoverable humic acid. Similar deposits surely exist in other arid and semi-arid parts of the world and only await discovery.

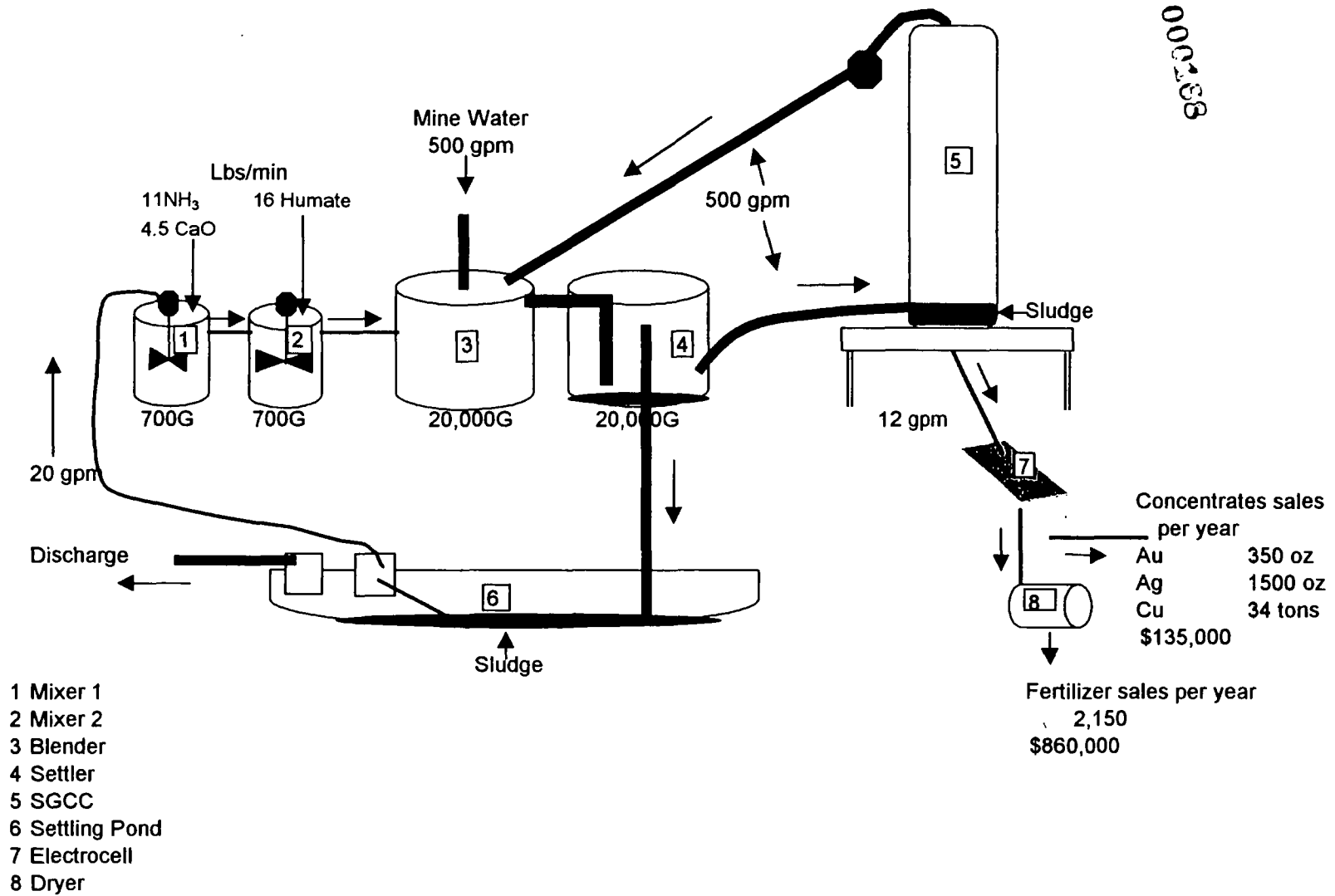
Literature Cited

1. Achard, F.K. 1886(?) *Chemische Untersuchung des Torfs*, *Crell's Chem. Ana.* 2: 391-403
2. Beckley, V.A. 1921. The preparation and fractionation of humic acid. *J. Agr. Sci.* 11: 66-8
3. Berthelot, M. and G. Andre, 1892. *Recherches aur les substances humiques*. *Ann. Chim. Phys.* 25 (6): 354-403
4. Bottomley, W.B. 1913. Ammonium humate as a source of nitrogen for plants. *J. Soc. Chem. Ind.* 32:920-4
5. Burdick, E.M. 1961. Process for treating humus materials. U.S. Pat. 2,992,093.

6. Caraway, H. 1953. Domestic substitutes for quebracho in oil well drilling fluids. *Petroleum Engr.* 25 (12) B:81-92
7. Carls, H. 1953. Present state of humic acid research. *Pharm.* 8:161-3
8. Duchaufour, P. and F. Jaquin. 1963. The extraction and fractionation of humic compounds controlled by electrophoresis. *Ann. Agr.* 14 (6):885-918
9. B-----?, A. 1910 (?). Influence of humus substances on the development of yeast and Ethel alcohol fermentation. *Biochem. Centr.* 9:704-10
10. Frickson, J.G. 1957. Polyquaternary ammonium compounds as soil conditioners. U.S. Pat. 2,807,910
11. Fischer, P.W. 1955. Electrically conductive drilling fluids. U.S. Pat. 2,721,841
12. Fisher, H.B. 1950. Drilling mud clay. U.S. Pat. 2,515,207
13. Flang, W. 1940. Chemistry of humus materials. *Suomen, Kemistilchti* 33A:229-51
14. Forsyth, W.G.C. 1947. Studies on the more soluble complexes of soil organic matter. A method of fractionation. *Biochem J.* 41:176-81
15. Fujii, Shuya. 1939. Infrared absorption of humic acid and alkali treated humic acid. *Neuryo Kyokaishi* 38:267-73
16. Guininiski, S. 1960. Influence of humic materials on the respiration of roots. *Aeta Agrobotan.* 9:123-7
17. Hock, A. 1937. Chromatographic separation of brown and gray humic acids. *Bodenk, Ph. Ernhr.* 5:1-8
18. Huge, P. 1960. Production of humic acids under controlled conditions. *Bull Inst. Agroa. Sta. Rech. Gambloux* 28:177-9
19. Isukal, Toyobaru, and Yutaka Shibuya. 1959. Industrialization of the manufacture of humic acids and their salts. *Nonryo Kyokaishi* 38:296-300
20. Iswaran, V. 1960. Effect of humified organic matter on nitrogen fixation by *Azotobaceter*. *J. Indian Soc. Soil Sci.* 8:107-13
21. Kaindl, K. and H.H. Mayr. 1958. Inhibiting effect of humus on the fixation of phosphates in soil. *Atom praxis* 4: 407-11
22. King, C.J. and H.F. Loomis. 1929. Cotton root rot investigations in Arizona. *Jour. Agr. Res.* 9:199-221

23. Kononova, M.M. and K.V. Dyakonova. 1958. Effect of humus fertilizer on plant growth. Intern. Soc. Soil Sci. Trans. II and IV Comin. Hamburg. 2:56-9
24. Kortleven, J. 1961. Organic matter in humus. Landbouwwoorlichting 18:130-5
25. Kristevn, I.A., et al. 1954. The reciprocal relation between mineral and organic nutrition of higher plants and the utilization of humic acids as fertilizers. Pochvovedenie (12):1-10
26. Kosuka, Jiro, et al. 1961. Fractionation of humic acids by organic solvents. Nippon Dojo-hiryogaku Zagshi 32:333-7
27. Kotlyuba, V.G. and V. A. Renton. 1963. Effect of humic acid on assimilation of phosphorus by plants and function of the surrounding temperature. Zh. Biol. Abstr. No. 14 G 24
28. Lanford, M.B., et al. 1938(?). Reduction of soil populations of the ----? Nematode -- -- method during decomposition of organic matter. Soil Sci. 45:127-41
29. Mack, K. 1922. The influence of humic acid upon the acidulation of phosphorus. Chem. Ztg. 46:??-?
30. Marcinck, J. ?. Chemical composition of the organic matter of peat soils. Zeszyty ? ? Postepow Nauk Rolniezych No. 34:127-38
31. Mareuson, J. 1922. The structure and formation of humic acids and coals. Zangew Chem. 35:165-6
32. Misterski, W., and W. Loginow. 1959. Physiochemical properties of humic acids. Sbornik Ceskoslovakad. Zemedel, ved, Rostlinna vyroba 5:457-78
33. Monnier, G, et al. 1959. Dynamic approach to the organic materials of the soil. Compt. Rendu. 248:138-41
34. Mukasova, V.L. 1961. The effect of humate fertilizers prepared from lignites on growth, development and yield of cotton. Akad. Nauk. USSR, Inst. Khim. 142-60
35. Mukhersee, P.N. et al. Fertilizers from coal. I. Production. II. Field trials. Proe. Natl. Acad. Sce., India Sept. A 31:124-6.
36. Okuda, Azuma, and Katsuihiko Tokubo. 1957. Seepage preventing effect of synthetic soil conditioners in paddy fields. Soil and Plant Food 2:215-19
37. Pivovarov, L.R. 1962. The nature of the physiological activity of humic acids in relation to their structure. Primeneniya Kiev: Gns. Izd. Selakokhoz. Lit. Ukr.

Brewer Gold Mine Water Flowsheet **500 gpm**



**MIDCONTINENT**

TESTING LABORATORY

2381 South Plaza Drive • P.O. Box 3388 • Rapid City, SD 57709
605/348-0111SAMPLE NAME: KM-11A
DESCRIPTION:
SAMPLE DATE: 08/17/99
SAMPLE TIME:
SAMPLED BY:JIM McLAIN 68001
BREWER GOLD COMPANY
ROUTE 2 BOX 57
JEFFERSON, SC 29718ACCOUNT NUMBER: W1004
LAB NUMBER: 19990820101
DATE RECEIVED: 08/19/99
TIME RECEIVED: 12:15 PM
REPORT DATE: 08/23/99

PHYSICAL PROPERTIES	VALUE	METALS mg/l	DISSOLVED	TOTAL
Conductivity, umhos/cm	.	Aluminum	.	.674
Hardness	.	Antimony	.	.
PH	8.49	Arsenic	.	.
Solids, Dissolved, mg/l	5231.	Barium	.	.
Solids, Suspended, mg/l	.	Beryllium	.	.
Turbidity, NTU	.	Boron	.	.
		Cadmium	.	.
		Calcium	.	.
		Chromium	.	.
		Cobalt	.	.
		Copper	.	.065
		Gold	.	.
		Iron	.	<.050
		Lead	.	.
		Lithium	.	.
		Magnesium	.	123.
		Manganese	.	.
		Mercury	.	.
		Molybdenum	.	.
		Nickel	.	.
		Potassium	.	118.
		Selenium	.	.046
		Silicon	.	.
		Silver	.	.
		Sodium	.	.
		Strontium	.	.
		Vanadium	.	.
		Zinc	.	.
INORGANIC & NONMETALLIC	VALUE			
Acidity	.			
Alkalinity	.			
Bicarbonate	.			
Carbonate, mg/l	.			
Chloride, mg/l	.			
Cyanide, Total, mg/l	.			
Cyanide, WAD, mg/l	.			
Cyanide, Free, mg/l	.			
Fluoride, mg/l	.			
Nitrogen, Ammonia, mg/l	350.			
Nitrogen, Nitrate, mg/l	9.28			
Nitrogen, Nitrite, mg/l	.			
Sulfate, mg/l	3667.			

000100

APPROVED BY: *J. M. D.*DATE: 08-23-99



MIDCONTINENT

TESTING LABORATORIES

2384 South Plaza Drive • P.O. Box 3388 • Rapid City, SD 57709
605/348-0111

SAMPLE NAME: B-6 SEEP
DESCRIPTION:
SAMPLE DATE: 09/28/98
SAMPLE TIME: 10:00 AM
SAMPLED BY: JIM MCLAIN

JIM MCLAIN 68001
BREWER GOLD COMPANY
ROUTE 2 BOX 57
JEFFERSON, SC 29718

ACCOUNT NUMBER: W1004
LAB NUMBER: 19980929303
DATE RECEIVED: 09/29/98
TIME RECEIVED: 09:25 AM
REPORT DATE: 09/30/98

PHYSICAL PROPERTIES	VALUE	METALS mg/l	DISSOLVED	TOTAL
Conductivity, umhos/cm	.	Aluminum	.	228.
Hardness	.	Antimony	.	.
PH 2.24	.	Arsenic	.	<.080
Solids, Dissolved, mg/l	5135.	Barium	.	.010
Solids, Suspended, mg/l	.	Beryllium	.	.006
Turbidity, NTU	.120	Boron	.	.271
		Cadmium	.	.006
		Calcium	.	.
		Chromium	.	.102
		Cobalt	.	.636
		Copper	.	55.5
		Gold	.	.025
		Iron	.	784.
		Lead	.	<.001
		Lithium	.	.
		Magnesium	92.5	.
		Manganese	.	2.73
		Mercury	.	.0163
		Molybdenum	.	.008
		Nickel	.	.674
		Potassium	9.55	.
		Selenium	.	.077
		Silicon	.	.
		Silver	.	<.001
		Sodium	82.9	.
		Strontium	.	1.72
		Vanadium	.	.018
		Zinc	.	.207

INORGANIC & NONMETALLIC	VALUE
Alkalinity	.
Bicarbonate	.
Carbonate, mg/l	.
Chloride, mg/l	.
Cyanide, Total, mg/l	.
Cyanide, WAD, mg/l	.
Cyanide, Free, mg/l	.
Fluoride, mg/l	.
Nitrogen, Ammonia, mg/l	2.61
Nitrogen, Nitrate, mg/l	7.08
Nitrogen, Nitrite, mg/l	<.050
Sulfate, mg/l	3520.

000170

APPROVED BY:

DATE:

[Signature]
09-30-98



GEOCHEMICAL ANALYSIS CERTIFICATE

Meyers, Karl F. File # 9901335

P.O. Box 60261, Las Vegas NV U.S.A. 89160



SAMPLE#	Mo ppm	Cu ppm	Pb ppm	Zn ppm	Ag ppm	Ni ppm	Co ppm	Mn ppm	Fe %	As ppm	U ppm	Au ppm	Th ppm	Sr ppm	Cd ppm	Sb ppm	Bi ppm	V ppm	Ca %	P %	La ppm	Cr ppm	Mg %	Ba ppm	Ti %	B ppm	Al %	Na %	K %	W ppm	Tl ppm	Hg ppm
5599-1	7	495	1492	71	104.2	28	16	117	.98	185	1114	<2	<2	112	1.4	14	<3	102	2.02	.201	13	28	.36	79	.01	167	1.14	.06	.13	57	<5	<1
5599-2	7	91	266	57	2.4	28	14	74	.85	201	1164	<2	<2	100	1.2	17	<3	76	.43	.199	13	15	.03	57	<.01	12	.30	.02	.07	71	<5	<1
5599-3	5	70	457	2	<.3	1	1	<2	.04	<2	<8	<2	<2	496	2.4	<3	<3	<1	15.75	<.001	<1	<1	.03	3	<.01	6	20.05	.01	.03	5	<5	<1
RE 5599-2	7	86	292	55	2.7	28	14	76	.80	194	1110	<2	<2	96	1.3	15	<3	75	.45	.194	12	14	.03	56	<.01	14	.32	.02	.07	70	<5	<1
5599-4	<1	2614	931	340	21.3	36	9	148	19.23	<2	14	4	30	17	<.2	<3	7	11	.24	.016	23	117	.12	14	.02	83	2.41	.11	.87	<2	10	9
5599-5	2	2256	2011	212	24.9	12	7	151	25.81	<2	13	3	37	11	<.2	71	5	30	.21	.014	20	107	.07	8	.08	777	1.38	.17	.50	<2	5	14
5599-6	<1	12320	420	171	18.4	87	161	643	10.49	<2	17	4	16	137	2.4	<3	<3	16	2.18	.004	119	37	.83	16	.04	73	8.08	1.01	3.92	<2	7	<1
5599-7	1	13295	3135	713	2.6	58	62	901	11.81	12	39	<2	<2	30	.3	<3	<3	316	.41	.027	2	190	2.66	127	.18	96	4.21	.10	.08	<2	<5	<1
5599-8	1	21341	20	728	<.3	56	61	823	10.81	9	<8	<2	<2	38	.4	<3	<3	305	.40	.019	1	166	2.50	162	.14	14	3.40	.03	.04	<2	<5	<1
5599-9	3	61	142	609	.5	34	107	22442	38.89	<2	<8	<2	56	25	<.2	<3	<3	867	.15	<.001	43	480	1.11	126	.26	22	.67	1.22	.01	<2	<5	<1
5599-10	4	55	153	614	.5	34	108	20790	39.92	<2	<8	<2	58	26	<.2	<3	<3	871	.15	<.001	45	495	1.12	128	.26	19	.68	1.27	.01	<2	<5	<1
STANDARD C3	23	64	33	157	5.6	34	12	842	3.32	57	22	3	21	27	22.0	15	20	80	.53	.082	18	167	.56	144	.10	17	1.79	.04	.16	13	<5	1
STANDARD G-2	1	3	<3	37	<.3	8	4	561	1.99	<2	<8	<2	3	73	<.2	<3	<3	40	.64	.090	7	80	.57	242	.15	<3	.95	.09	.49	<2	<5	<1

ICP - .500 GRAM SAMPLE IS DIGESTED WITH 3ML 2-2-2 HCL-HNO₃-H₂O AT 95 DEG. C FOR ONE HOUR AND IS DILUTED TO 10 ML WITH WATER.

THIS LEACH IS PARTIAL FOR MN FE SR CA P LA CR MG BA TI B W AND MASSIVE SULFIDE AND LIMITED FOR NA K AND AL.

- SAMPLE TYPE: PULP Samples beginning 'RE' are Reruns and 'RRE' are Reject Reruns.

DATE RECEIVED: MAY 11 1999 DATE REPORT MAILED: May 18/99 SIGNED BY: C. Leong D. TOYE, C. LEONG, J. WANG; CERTIFIED B.C. ASSAYERS

Assay recommended for Cu, > 1%
Ag > 30ppm

5599-6 - Brewer Gold Sludge

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*Brewer Gold Mine
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BREWER GOLD COMPANY

**OPERATION AND MAINTENANCE OF WATER TREATMENT
PLANT**

OTHER RECLAMATION REQUIREMENTS

By

James McLain

Environmental Manager

July 1, 1999

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BREWER GOLD COMPANY

WATER TREATMENT AND FACILITY MANAGEMENT

Acidic ground water flows from springs on the Brewer property at a rate of approximately 120 gallons per minute or approximately 63 million gallons per year. These flows are collected at the Eastern edge of the old B-6 mine pit and are referred to as B-6 acid water. The water is pumped, using tandem electric pumps backed up by a Diesel operated pump, and sent to the former Pad #6 Overflow Pond, commonly referred to as Pad 6 pond. This is a double lined pond with leak detection capable of holding 18 million gallons.

Water is pumped from the Pad 6 Pond to the water treatment plant at a rate of approximately 1500 gallons per minute and treated in 3+ million gallon batches. The treated water overflows into an old abandoned mine pit called the NW pit. Here the sludge separates from the water and is allowed to settle in the pit. The water which now meets EPA discharge parameters is pumped to the NPDES out flow at rates dependent stream flow.

The B-6 acid water requires that a period of oxidation must occur before neutralization with either Magnesium Oxide (MgO) or lime (CaO). This is done by allowing the water stored in the Pad 6 pond to circulate at least 2 days before treatment. The circulating water is encouraged to spread out in a thin film across the plastic liner. This provides for the greatest surface area and therefore increased contact with oxygen.

When treatment begins, all valves are checked to ensure that the acid water is not inadvertently allowed to flow beyond the NW pit area. A single valve that is not tightly closed could contaminate the Fresh Water Pond. As we are usually discharging from the FWP simultaneously, there is the added potential of releasing acid water through our outfall. This could result in damage to the creek, not to mention the possible fines imposed by DHEC.

In preparation for batch treating; dry, bulk, magnesium oxide (MgO) is hydrated with fresh water in the mixing tank which then stores 14,000 gallons of MgOH. As B-6 water is pumped from pad 6 pond at the desired rate, MgOH is metered from the mixing tank into the B-6 water incoming line through a mixing valve. This treated water is pumped into two 20,000 gallon agitating tanks allowing a twenty minute retention time before overflowing into the NW pit.

The optimum pH of the treated water in process is around 4.8, as measured in the retention tanks. This pH is achieved by manipulating the factors that control the treatment. These factors are:

- a) The flowrate of the incoming waste stream

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- b) The concentration of the MgOH slurry.
- c) The feed rate of the slurry solution

As the temperature of both the water and the air will effect the rate of reaction, the ratios of the above factors will change with the seasons. All parameters are tested in the lab prior to treatment of a batch.

The B-6 water is treated in batches of approximately 3.3-MG. This figure correlates to a single tanker load of MgO. Two of these treatments per month will not only maintain adequate freeboard in the Pad 6 Pond, but will also provide the opportunity to treat the water collected in the Sediment Pond as it accumulates.

The Sediment Pond water is treated as needed to prevent an unexpected discharge. Since the pond is fed only by surface runoff, the treatment scheduled is determined by rainfall events. The intensity and quantity of the rainfall will dictate the total volume collected. In general, one inch of rain will result in an increase of about one million gallons in the pond.

The treatment of Sediment Pond water takes place in the NorthWest pit using lime slurry (CaOH) instead of MgOH. The success of this treatment is dependent on:

- a) The pH of the raw Sediment Pond water.
- b) The load of metals contained within the water as indicated by the Copper content.
- c) The pH of the water, if any, within the treatment pit.

Frequently, Sediment Pond water is used as a polishing agent for a batch of B-6 water that has already been partially neutralized with MgOH. In this case, bench test are usually conducted to get a rough idea of the amount of Sediment Pond water, treated to a specific pH, required to bring the total volume into specifications. The Sediment Pond water needs to be brought to at least a pH of 9.3 in order to remove a stubborn species of Al that seems to reside there. If the water is brought to a pH of 9.3, there must be a settling period to allow natural degradation to drive it down to 9.0. Again, the temperature variation of the seasons plays a significant role in choosing the methods of treatment.

Discharging Treated Water

The NPDES permit for Brewer Gold Mine is based on a loading criterion. It is allowed to discharge a predetermined mass of contaminants (TSS, oil and grease, cyanide, arsenic, copper, lead, mercury, zinc, cadmium, silver, aluminum, selenium, ammonia, pH, and nitrate-nitrite) into a given volume (MG) of streamflow. The permit also states the maximum daily limit of loading. (Lb./MG)

In order to lawfully discharge treated wastewater, the concentration of each of these contaminants and the total daily volume of Little Fork Creek must be known. The amount of each contaminate can only be precisely measured by an independent, certified

lab. This requires that a sample be sent and analytical results transmitted back. Fortunately, the methods of treatment and the nature of the wastewater are constant enough that the concentration of copper provides a good indicator to the rest of the contaminants. Having the copper value and a general knowledge of the history of the waste treatment allows one to reasonably estimate the individual quantities of the remaining parameters.

The USGS Stream Monitoring Station, located at the bridge on Highway #268, measures the stream volume. Data related to the stream level is relayed to the state data bank in Columbia. By logging on-line, via telnet, Brewer downloads stream levels and computes daily volumes.

These two factors, contaminate concentrations and stream volumes, are used to calculate the exact flowrate what will:

- a) not surpass our maximum daily loading limit,
- b) not surpass our monthly average loading limit on each contaminate,
- c) maintain a safe water balance.

Discharge weeks consist of up to seven consecutive days of release. If, for any reason the flow should be interrupted, a new discharge week begins. The waste stream is sampled and sent for analysis each discharge week. In addition, the pH and the integrity of the discharge are monitored each day of the discharge week.

It is sometimes advantageous to discharge at a very low rate one week, in order to reduce the overall monthly loading average. This allows for an increased discharge rate at a later date within that month. Care should always be given not to exceed the daily max.

The use of evaporation techniques is another way to maintain a safe water balance. This is especially useful during the summer months when stream volumes are very low. These include the spraying of Sediment Pond water over the Waste Rock Dump area and pumping of treated water into the Process Ponds. Additional evaporation occurs from the Pad 6 Pond and the NW pit.

When using the Process Ponds, the water levels should always be maintained low enough to contain any additional runoff, without danger of surface discharge. If needed, this excess water can be pumped to the Pad 6 Pond for re-treatment. As it has a very low metals content, pretreatment costs are slight.

The water level within the NW pit should be rather low between treatments. This allows the surface of the sludge layer to be exposed to evaporation thereby reducing its volume.

In conclusion, while treatment is a batch process, discharging that water is almost a continuous operation. The Fresh Water Pond should always contain enough treated water to maintain a low volume discharge during the period that new treatment is occurring in the NW pit.

Governmental Records, Reports and Environmental Sampling

Most governmental requirements are mandated in the NPDES permit. These include the following:

- a) The sampling of the wastewater discharge each week
- b) The submission of the Monthly Discharge Report (DMR). (This document serves as proof to the State that all of the water discharged that month meets the standards set forth in the NPDES Permit. All analytical data must be verifiable through a State Certified laboratory. Brewer uses Core Labs in Aurora, CO.)
- c) The submission of the quarterly monitor well analyses.
- d) The submission of the Stream Assessment for Little Fork Creek. (This report is intended to determine the general health of Little Fork Creek through the sampling and classification of its macroinvertebrate communities. The importance of this study should not be underestimated. Brewer Gold currently is operating under a consent order that suspends the maximum discharge limits of Al and Se as long as the Macro Study shows LFC healthy. The creek is most vulnerable during the dry summer months when the pH of the low streamflow can be easily altered due to relatively small amounts of acidic water. Heavy rainfall events can also choke the aquatic life with sediment.)

The Stream Assessment is conducted three times per year.

- e) An annual Water Balance Report must be submitted.
- f) This report chronicles all water either reporting to or discharging from the mine site.
- g) The development of a Stormwater Discharge Plan, which requires that runoff from the site, meets certain parameters such as turbidity and velocity limits. This Plan is considered part of the NPDES Permit.
- h) The development of a Wastewater Operations Manual, including the Best Management Practices manual, to ensure that all treatment methods are documented. These manuals must be readily available to DHEC at any time.
- i) The development of an Emergency Preparedness Plan to be used in the advent of an unexpected discharge or other environmental crisis.

Other periodical reports include:

- a) The Quarterly Progress Report, which documents the advancement of the Reclamation Plan.
- b) The Annual Reclamation Report, which keeps a yearly total of the reclaimed acreage.
- c) Submission of the SARA II report to local emergency agencies. This informs emergency responders of the types and location of all potential risks.

Since Brewer Gold has recently been reclassified as a non-generator of hazardous waste, the Quarterly Hazardous Waste Report is no longer required, but the Federal EPA ID number remains active in the event that such waste be produced again.

Each month, Brewer samples the B-6 Seep for analysis as well as gathering information on flowerets. This is available to DHEC upon request.

Other activities include:

- a) The daily collection of weather data, (high and low temperatures, rainfall, evaporation) to be used when completing the Annual Water Balance Report.
- b) The monthly recording of the water levels in each of the active monitor wells.
- c) The recording of the piezometric values from the sensors within the Pad 6 Pond Dam.
- d) Maintaining the Official Discharge Recording chart located behind the Sediment. Pond Dam. This circular chart records the volume of wastewater passing through the outfall on Little Fork Creek. It is always active, showing periods of no discharge as well. Each chart covers a single week, but is not necessary the same as a discharge week. This chart and the accompanying flowmeters must be calibrated each year by a state certified company. Calibration occurs in December of each year.

TREATMENT FACILITIES MAINTENANCE

Pumping Systems

The primary concern at Brewer is the treatment of acidic water. The corrosive nature of this water demands that all pumping systems be of the highest quality and maintained to very rigid standards. Fortunately, Brewer had the forethought to purchase high caliber pumps, valves and piping. Weekly preventive maintenance, consisting of lubricating, cleaning and inspection, has allowed these systems to continue operating at near-peak performance.

When discussing the operation of these pumping systems, there are several conditions that may require additional attention. The effects of freezing weather must be anticipated and prepared for. Severe electrical storms will cause certain systems to fail, requiring manual reset procedures. The extreme heat will stress other systems that must run in a continuous mode. As usual, periodic cleaning to remove acid-producing dirt is necessary.

Treatment Systems

Maintenance of the various components of the treatment system is very closely related to the rest of the pumping equipment.

The different tanks utilized to treat the acidic water require little maintenance other than periodic sandblasting and repainting. The neutralizing reagent, which has a very low solubility rate, remains in suspension while in the retention tanks. This produces a very abrasive mixture that will cause the metal to be exposed.

The agitators require a complete cleaning after each treatment batch. The magnesium oxide dust tends to coat the motor and the gearbox causing overheating and seal deterioration. Electrical connections should be checked regularly as the vibration may cause failure.

The baghouses and augers on the silos are affected by the accumulation of MgO dust. The sifting action on the bag deduster will wear holes in the cloth dust bags if they are not properly aligned. All silo manholes must be kept watertight to prevent the MgO from becoming hydrated and clogging the augers.

Both the sonic flowmeter and the rheostat controllers at the Northwest Trend must operate in an environment that is protected from rain, dust, extreme heat, direct sunlight and vibration. Care must be taken to ensure that proper electrical grounding is maintained at all times. When the electrical equipment is not being used, the manual cutoff switches are thrown.

OTHER BREWER RECLAMATION REQUIREMENTS

Revegetation and erosion control

It is essential to establish a protective cover of vegetation and control erosion for two reasons. First, there is the danger of choking Little Fork Creek with displaced sediment and second, the failure of the Brewer and B-6 Caps would allow the generation of acidic water within the backfilled areas.

Due to the shortage of topsoil, the plant life is rather hard to establish. It is necessary to fertilize several times during the growing season. The procedure has been to plant a succession of different grasses that increase in difficulty to become established. The order generally starts with a simple Pop-Up variety such as millet, which will either die of heat, or be choked out by a hardier cover such as Love Grass. The final cover will be a legume such as Lespedeza.

An important component to successful revegetation is recognizing the correct time to mow the existing growth. Proper mowing will help spread the natural seed while, at the same time, open the area to light, giving that seed the opportunity to grow.

Obviously, the best deterrent to erosion is healthy vegetation, but while it is being established, it is necessary to erect physical barriers that will either direct runoff toward

safe areas, or simply reduce the velocity of the surface flow. These barriers include berms, riprap, geomembrane materials, water collect and concentration areas that are drained with pipes, and bales of straw that cause the surface runoff to slow down and form a thin film across a larger area. An added benefit of the straw 'speed-bumps' is that its organic matter will provide nutrients to the soil. The straw also encourages other forms of wildlife to move into an area. Rabbit, mice, rats, snakes and birds help to create an environment that reduces erosion and increases the self-sufficiency of the protected zones.

The capped areas require that trees must not be allowed the opportunity to become established. The methods typically used to remove unwanted growth, such as deep plowing or poisons, are inappropriate here. The cap may be damaged by plowing, and runoff of the poison into the creek may endanger its health. Again, mowing at the correct time within the growth cycle seems to be the best solution.

Equipment maintenance

Maintenance of the equipment is essential to the operation on the mine site.

The main types of equipment in service here are:

- A) rolling stock, which include various earth moving machines, trucks, ATV's, and drilling rigs
- B) pumping systems, which include pumps, pipelines, valves, and monitoring stations
- C) treatment systems, composed of silos, mixing tanks, agitators, electrical starters and controllers
- D) buildings such as the office, lab, shop, and various storage sites. Within each, there is equipment that requires periodic maintenance.

The following is a rough outline of the maintenance required for each of the above.

Rolling Stock

The servicing of the various pieces of mobile equipment is dependent on the needs of the individual unit, the environment in which it is operated, and the period between recommended maintenance. In general, the number of hours of operation and the type of work performed will dictate the frequency and extent of maintenance. One important component of any maintenance program is preventing the development of rust on this and all equipment. Due to the high concentration of sulfur compounds in the dust and rock of this area, any moisture will produce sulfuric acid, which will attack metal surfaces. Regular rinsing to remove sediment buildup and repainting exposed metal is necessary. Another unique property of this area is the extremely hard nature of the rock. Frequent inspection of all wear surfaces will prevent expensive repairs at a later date.

Buildings and Storage Sheds

Most of the maintenance of the buildings involves the heating and air-conditioning systems. Changing the filters and rinsing the outside heat exchangers are important in this dusty environment. The AA in the lab, which is very sensitive to contamination, has its own rigid preventive maintenance schedule.

Maintenance at the shop is more complex. The air compressor, welding equipment, lubricating systems and gas heating system require individual attention to prevent costly breakdowns. Care should also be given that the metal sheeting of the outer walls remain above the dirt line, as it will quickly rust.

Purchasing

As the reclamation activities begin to settle into predictable patterns, purchasing supplies has become much easier.

As the rainfall volumes dictate the schedule for Sediment Pond treatment, an abundant supply of lime should always be on-site. The MgO inventory is trickier due to the limited period that it can be stored safely in the silos. The danger of hydration increases with the relative humidity and residence time in the silos.

The rest of the materials needed to maintain an effective operation are purchased from venders with whom we have developed a long-term relationship.

Personnel

The three hourly operators have been gleaned from a pool of over 130 workers. They were selected to stay because each brings his own talents and skills to the mine Site. In today's labor market, it would be very difficult to match, much less replace, these abilities.

Brewer personnel represent over 70 years of accumulated experience working on this site. It would be a very foolish manager who didn't take advantage of this wealth of knowledge. Every worker should be encouraged to feel as though they have a personal stake in the success of this operation. This is easily accomplished by having a manager who seeks out their opinions and advice.

Each of the hourly workers has been given a major area of responsibility. These areas include:

A) water treatment

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- B) equipment operation and maintenance
- C) erosion control and revegetation

The tasks in each of these areas often require the services of all three workers, but it is the responsibility of the man in charge of that area to direct, and be accountable, for the completion of the project.

There has developed an unusually enjoyable working relationship between labor and management at the Brewer site. In spite of the tension and anxiety related to the numerous lay-offs and the inevitable closing of the mine site, these men have maintained the highest levels of work quality and moral. If they are treated fairly and with dignity, they will produce amazing results.

Jim McLain

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Brewer Gold Mine.
11.9 Vol 3

BREWER GOLD COMPANY
DRAFT REPORT ON SITE VISIT
18 - 20 MAY 1999

A W J Cook

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Introduction

A W J Cook visited the Brewer Gold Mine site, Chesterfield County, South Carolina on Tuesday 18 May and Wednesday 19 May 1999. The reason for the visit was to discuss the following reports:

"Lowering the Groundwater Elevation to Stop Groundwater Contamination by Acid Mine Waste" dated 5 April 1999; Author Bud Long (Reference 1).

"A Summary Report of Groundwater Features Observed at Brewer Gold Company Property, Chesterfield County, South Carolina" dated 9 April 1999; Author Roger Q Callaway (Reference 2).

Review on site archive geological data and carryout a walkover site inspection. The objective was to consider the way forward for dealing with acid drainage emanating from the backfilled mine.

Pit Backfilling

The methodology and rationale of how and why the Brewer Pit and B6 Pit were backfilled was discussed. It was confirmed that the main components of the closure plan given in the Report *"Control of Acid Rock Drainage by Pit Backfilling"*; Authors Anne Lewis-Russ et al, were generally followed during backfilling operations. It was pointed out that the closure plan appeared to ignore any reference to the structural geology of the site and surrounding areas and concentrated on the geochemical reactions of the various backfill materials with water and oxygen, the "clean up" and revegetation requirements.

The actual method of backfilling both Brewer Pit and the B6 Pit was discussed in detail. In particular the second layer up from the bottom which is referenced as material HLP1-4 and visually described as having a content of fine grained "silty material" which had clay like platy crystals. This material was compacted to 95% of its standard Proctor density near optimum moisture content. It was also within this material that the Brewer Pit sub-drain was constructed. This sub-drain is believed to be currently "dry". HLP1-4 material was placed in the region of the sub drain as it was believed to be relatively innocuous and acid generation was not anticipated.

The monitoring wells MW14 and MW16, which are outside the confines of the Brewer Pit, infer that the groundwater level in the Brewer Pit subsequent to backfilling is at an elevation between 441 and 432 feet above datum. The groundwater level may be slightly higher and could be coincident with the top of the sub-drain inlet.

It is possible that the water level inside the Brewer Pit may be at a higher elevation than that indicated by MW14 and MW16 within weak rock fill and be "sitting" on top of the HLP1-4 material layer. In fact, this HLP1-4 material layer could be acting as an aquiclude and preventing the ingress of water into the drain from the Brewer Pit. If there was any groundwater above this layer (HLP1-4), the water would probably preferentially travel down gradient in an easterly direction towards Little Fork Creek, possibly along the top of the sub-drain.

The materials above the HLP1-4 layer comprised waste rock which had a much higher permeability than the HLP1-4 layer above which a much lower permeability "capping layer" HLP-6 was placed.

Geology

The geological records show that the Brewer Pit and the B6 Pit areas had suffered several structural alterations (folding and faulting), which resulted in the formation of the complex ore body. The records also indicate numerous cross cutting breccia pipes, particularly towards the east, the breccia includes highly fractured quartz and will thus have high secondary permeabilities.

A W J Cook and R Callaway researched archive geological maps of the mine area and in particular the bench maps for the Brewer and B6 Pits. These maps indicated the existence of numerous joints and fissures along the walls of the pits and local fractured systems. Blasting during mine construction would have induced some of these discontinuities.

It was pointed out that on the drawing on page 9 of Roger Callway's Report (ref 2), blue lines indicating major faults were plotted and these should be considered as being of primary interest. These major faults, which ran in the general directions of north to south and west to east across the Brewer Pit, had been recorded on some of the archive geological maps. The major west to east trending faults were shown to extend across into the B6 Pit. The fault running north-east to south-west across the eastern end of the B6 Pit may be only an inferred fault as it was not that well defined on the maps.

The Tanyard Syncline on page 7 "*Topography, Pit Outline Geology*" (ref 2) which is "canoe shaped" runs approximately east - west towards the south of the Brewer Pit. This syncline may not have a major influence on the groundwater regime around Brewer Pit and B6 Pit, apart from influencing the groundwater seeps towards the south east of the site in the region of MW 2R as shown on page 9 (ref 2). These seeps were seen on site during the visit.

The monitor well MW3, which is located on the northern limb of the Tanyard Syncline, has in the past been shown to be artesian, this is probably due to recharge from the southern limb which is at a higher level.

Groundwater

The groundwater flows on the site would appear to have followed the topography; this has developed a dendritic drainage system. A spring "Bud's Seep" was recorded to the north side of the B6 Pit at an elevation of about 425 feet, as shown on page 9 of R Callaway's Report (ref 2).

A W J Cook and R Callaway inspected this area on 19th May 1999 and it would appear that this spring (Bud's Seep) probably emanates from a point where two discontinuities conjugate. The lower discontinuity dips approximately to the northeast and the upper discontinuity dips approximately to the southwest.

The groundwater regime in rocks is generally controlled by porosity, which is responsible for the primary permeability and the discontinuities within the rock (i.e., fissures, joints, faults etc), that provides the secondary permeability. The groundwater regime on Brewer Hill is fracture dominated. Thus secondary permeability is the prime consideration.

Concerns

Capping and Grassing:

The revegetation and capping programme has been completed and remedial work is currently being carried out to the capping layer that has been subject to storm damage and the cutting down of small trees where the roots may penetrate the capping layer. These types of remedial work and grass cutting will be ongoing for the foreseeable future.

Waste Rock Disposal Area:

The waste rock disposal area south of Brewer Pit, which was used to store waste rock, had somewhat been cleared. Groundwater flow into and through this area has lead to acid seep generation particularly at the lower end of the area. As suggested by Bud Long, this heap area should be cleaned off by "water jetting" down to bare rock face and the ensuing water and sludge should be collected and disposed of. Once this has been achieved, it is unlikely that there will be longterm ongoing problems in this area.

B6 Pit Acid Seepage:

The acid seepage from the B6 Pit is the main concern at the moment. The pH levels are currently running at less than 3 (2.4 on 26th March 1999) and it is the consensus from site that we should try to achieve a reduced acidity to a pH4 level or above, which would then be in accord with the normal "background"

April Trials:

The April Trials are briefly described as Task One in Bud Long's Report (ref 1). This comprised drilling 4 number observation holes that were located outside the confines of the B6 Pit at the eastern most extremity near the Little Fork Creek. After the holes were drilled, on 19th April 1999 sump pumping was carried out from the shallow "sump" within the B6 Pit. After the first 5 hours, the Acid Seep ceased to flow and remained dry for the 11 day pumping period.

The groundwater levels inside the observation holes initially ranged from 11 to 20 ft below ground level. These levels were lowered between 2 to 4 feet during this 11 day period. The Acid Seep began flowing again 5.75days after pumping had ceased.

The water samples that were taken from the observation holes did show an average marginal reduction in pH (4.59 to 4.25). During the trial period, 2.28 million gallons of water was pumped out of the sump which equates to about 140 gallons per minute. It is not possible to ascertain a value of permeability from the trial data obtained, the usefulness of which is debatable.

The results of the April Trials did not invalidate the proposal as described in Bud Long's Report (ref 1). The greater the reduction of acidity due to dilution or the drawing in of outside groundwater and/or reducing the cone of depression below the bottom of the B6 Pit, will result in savings on the current groundwater (Acid Seep) treatment costs.

The groundwater regime around both the Brewer Pit and the B6 Pit should be investigated in order to pursue the proposals outlined in Bud Long's Report.

The proposal suggested that the groundwater level be lowered below the base of the B6 Pit by the installation of a gravity drainage system. It is believed that this would possibly result in a less acidic groundwater seep at the eastern end of the pit. It maybe that the groundwater seep attains an acceptable background pH level and be allowed to be pumped directly into Little Fork Creek. This is a possible solution, but in order to consider this further, the groundwater regime and the response to groundwater lowering at the east end of the B6 Pit needs to be determined.

The depth below the bottom of the B6 Pit to the Little Fork Creek water level is only about 20 feet, which may be insufficient to achieve the required draw down around and under the base of the B6 Pit.

The gravity drain would have to be constructed from a bench cut alongside the Little Fork Creek and be at a very shallow inclination upwards and under the bottom of the B6 Pit. The rock through which the drain would have to be constructed would probably be hard (quartz pipes) and may be locally fractured due to blasting.

levels of other neighbouring areas which discharge into the Little Fork Creek. The treated acid water from this seepage has a pH of 8.3 to meet NPD Standards and is discharged into Little Fork Creek.

The State authorities are carrying out micro-invertebrate (critters) studies in the Little Fork Creek three times a year and things we are told are improving. This is the first time the State authorities have been involved in mine closures and their environmental impact. They would appear to be adopting a level of creek well being as a measure of improvement control, rather than sticking to rigid target levels.

Brewer Pit:

The main concerns with the Brewer Pit are:

- Where is the groundwater level within the pit?
- Is the groundwater seeping into the B6 Pit?
- Is the groundwater from the Brewer Pit seeping out at Bud's Spring?

If water is entering the Brewer Pit, where does the water come from and how does it gain access into the pit? The source of water is precipitation and the Brewer and B6 Pits are both capped with an impermeable layer, therefore surface penetration is unlikely.

There are faults running across both of these pits and the geological maps inspected indicated that the sidewalls of both the Brewer and B6 Pits had numerous discontinuities.

Thus it is likely that, if water is entering the Brewer Pit, access is via fissures in the rock. It is also likely that the north to south trending faults that cross the Brewer Pit are the major conduits, however the west to east trending faults should not be discounted as the geological maps that were inspected generally do not extend beyond the confines of both the Brewer and B6 Pits. The above would support the theory that the water flow is controlled by the structural geological conditions on site.

The initial thought was to construct an adit, but it may be more cost effective to drill out the drain using "down the hole" and possibly directional drilling methods.

The proposal received from Reclamation Technology Inc on Wednesday 19th May to carry out a clay slurry sealing and filling operation within the B6 Pit is probably feasible, but will be very difficult and expensive, initial estimates are in excess of \$6million. This solution will probably not alleviate the problem of groundwater flow and seeps may still have to be treated before being pumped into the Little Fork Creek.

The possibility of developing a solution involving a lime stabilisation process will be discussed with Stabilator during A W J Cook's visit to see them 4th and 5th June.

If the major fault zones are a source of water ingress into the Brewer Pit and/or the B6 Pit, then it would be possible to construct grouted barriers across these zones. This solution requires further studies to be carried out.

The possibility of installing grout curtains down the sides of the pits to contain and control the groundwater flow was also discussed.

The use of a geophysical investigation method of studying the groundwater regime was discussed and it is possible that resistivity or seismic refraction methods may be suitable. With regards to the groundwater level within the Brewer Pit, resistivity methods would probably be able to achieve a 30 - 60 feet resolution and seismic retraction methods which are more expensive would probably achieve a resolution of 15 feet.

Recommendations:

The groundwater regime, including the seeps around the Brewer and B6 Pits, must be investigated. It is extremely important to determine the groundwater level in the Brewer Pit as, if this is at a high elevation with groundwater running into the B6 Pit, then there will have to be a major rethink on the proposal outlined by Bud Long. This can be achieved by the following;

- (i) The construction of at least five number observation holes needs to be undertaken. These would be sited at specific locations around the Brewer and B6 Pits. Three of these holes can be drilled with the track drill, which is on site, the remaining two holes, which go deeper, will have to be drilled with a bigger subcontracted drilling rig. Slug tests should be carried out in these holes.

- (ii) The construction of three number observation wells which will be located at the eastern end of the B6 Pit. Two wells would be drilled outside the pit extremities and the third would be drilled into the lower end of the B6 Pit to a depth just above the pit bottom. These three wells would also require the bigger drilling rig. Slug tests should be carried out in these wells prior to pumping.
- (iii) Dye tracer studies would be carried out using inert dyes to attempt to identify the groundwater flow regime around both pits from the new holes /wells and several of the existing wells.
- (iv) The sub-drain that runs from the Brewer Pit to the B6 Pit should be investigated to ascertain as to whether it is working. This would need careful consideration and may be undertaken by installing observation holes into the sub-drain or by careful excavation at its eastern end in the B6 Pit.
- (v) Pumping tests would be carried out from the observation wells and the effect on the groundwater levels within the new and old observation holes would be recorded.

If the above recommendations are to proceed, then a detailed method statement will be required to be produced by an experienced geotechnical engineer. The fieldwork and evaluation of the results also should be carried out under direction of a suitably experienced geotechnical engineer.

A W J Cook
Geotechnical Adviser

1st June 1999

000181

Brewer Gold Mine
11.9 Vol 3

BREWER GOLD COMPANY

EXHIBIT A

GOLD RESOURCES, INC.

515 MADISON AVENUE
NEW YORK, NEW YORK 10022

(212) 759-1930

513 MINING EXCHANGE BUILDING
8 SOUTH NEVADA AVENUE
COLORADO SPRINGS, COLORADO 80903

(303) 633-2081

March 1, 1984

Mr. Kerry J. Stanaway
Nicor Mineral Ventures
Suite 4200, 4949 S. Syracuse St.
Denver, CO 80237

Dear Kerry:

Please find enclosed a copy of the Agreement between C. M. Tucker and Gold Resources concerning the Brewer property in Jefferson, South Carolina. The Agreement has been signed by all parties and will be recorded in South Carolina as soon as possible.

Sincerely,

Brian

Brian W. Hester
President

BWH/sm

circulate Paul Taylor
Bob Neal
Then file as above

file
① Brewer Legal-Title doc (copy)
② Vault - Agreements (original)

000002

copy 1-75

State of South Carolina)

County of Chesterfield)

AGREEMENT

WHEREAS, on the 28th day of March, 1979, C. M. Tucker, Jr. and wife, Alice G. Tucker of Pageland, South Carolina, and Dorothy H. Clark, a widow, never having remarried, of Jefferson, South Carolina, hereinafter called FIRST PARTY and Gold Resources, Inc. a private Corporation organized under the laws of the State of Delaware, having its principal place of business at 515 Madison Ave., New York, New York 10022, hereinafter called SECOND PARTY, entered into a certain Mining Lease With Option to Purchase, under the terms of which the FIRST PARTY leased and optioned the below described premises for a term of five years, and

WHEREAS, on March 28, 1979, the parties hereto executed a memorandum of said lease which was recorded on May 2nd, 1979, in Deed Book 257, Page 680-682 in the office of the Clerk of the Court, Chesterfield County, Chesterfield, South Carolina, and

WHEREAS, the parties hereto desire to amend the term of said Mining lease With Option To Purchase, to provide for an additional term of one (1) year commencing on March 28th, 1984, and amended certain other provisions, and the parties hereto desire to record a memorandum of said amendment,

NOW, THEREFORE, for and in consideration of the sum of Ten Dollars (\$10.00) and other good and valuable consideration, the receipt of which is hereby acknowledged, both parties hereby amend the lease-option agreement dated March 28th, 1979, by virtue of an Amendment to Mining Lease with

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Option To Purchase, dated the 23rd day of February, 1984, executed copies of which are in the files of both parties, on the following described premises, to wit:

All that certain piece, parcel or track of land situate, lying, and being in the County of Chesterfield, State of South Carolina, near the town of Jefferson, South Carolina, known as the "Brewer Mine", containing 1,000 acres more or less, the said property being more particularly described in "Exhibit A", attached hereto and made a part hereof.

The SECOND PARTY agrees that during the term of this lease that the FIRST PARTY has the right to cut and remove any merchantable timber from said premises.

IN WITNESS WHEREOF, the parties hereto set their hands and seals this 23rd day of February, 1984.

Signed, sealed and delivered
in the presence of:

Parale R. Robertson

C. M. Tucker, Jr.
C. M. Tucker, Jr.

Kenneth C. Smith
Witnessed for Lessors

Alice G. Tucker
Alice G. Tucker

Paul D. Dwyer

Dorothy H. Clark
Dorothy H. Clark
First Party

James F. Smith
Witnesses for Lessee

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Brian W. Hester
Gold Resources, Inc.
By: Brian W. Hester,
President,

Second Party

STATE OF SOUTH CAROLINA)
)
COUNTY OF CHESTERFIELD)

PROBATE

PERSONALLY Appeared before me Pamela R. Robertson
who being first duly sworn, says that she saw the within named C. M.
TUCKER, JR., ALICE G. TUCKER, DOROTHY H. CLARK, sign, seal, and as their
act and deed deliver the within written Agreement and that she with Eunice Smith
witnessed the execution thereof.

SWORN TO BEFORE ME THIS 23rd
day of February, 19 84.

Pamela R. Robertson

Eunice C. Smith

Brian H. Funderburk

NOTARY PUBLIC FOR SOUTH CAROLINA

My Commission Expires:
My Commission Expires April 3, 1988

STATE OF COLORADO)
)
COUNTY OF EL PASO) SS

On the 14th day of February, 1984, before me a Notary
Public, Personally appeared Brian W. Hester, personally known to me to
be an officer of Gold Resources, Incorporated, a private corporation
described in and which executed the foregoing Instrument, and be acknowledged
that he executed the same as an act and deed of Gold Resources, Incorporated.

Donna K. Euston

Notary Public in and for said
County and State

508 Mining Exchange Building
Colorado Springs, CO 80903

My Commission Expires:
5/16/84

000005

AMENDMENT TO
MINING LEASE WITH OPTION TO PURCHASE

WHEREAS, A Mining Lease With Option to Purchase was made and entered into on the 28th day of March, 1979, a memorandum of which was duly recorded on the 2nd day of May, 1979, in Deed Book 257, pages 680-682 in the office of the Clerk of the Court of Chesterfield County, Chesterfield, South Carolina, between C. M. Tucker, Jr., and Alice G. Tucker, his wife, of Pageland, South Carolina, and Dorothy H. Clark, a widow, never having remarried, of Jefferson, South Carolina, as Lessor and Gold Resources, Incorporated, a private corporation, having its principal place of business at 515 Madison Avenue, New York, New York 10022, as Lessee;

NOW, THEREFORE, in consideration of the sum of TEN DOLLARS (\$10.00), Lessor and Lessee agree to amend certain terms of said Mining Lease with Option to Purchase on the following described premises, to wit:

All that certain piece, parcel or tract of land situated, lying, and being in the County of Chesterfield, State of South Carolina, near the town of Jefferson, South Carolina, known as the "Brewer Mine" containing 1,000 acres more or less, the said property being more particularly described in "Exhibit A", of the original agreement.

1. It is agreed by Lessor and Lessee to amend and change Paragraph 2, Paragraph 3, Paragraph 21 and Paragraph 23 of said Mining Lease with Option to Purchase to read as follows:

2. TERM. The term of this lease-option shall be for a period of six (6) years from the date hereof. The lease may be extended one additional year so long as Lessee continues to mine or develop and pays the royalties as hereinafter provided, it being specifically understood the term of the option is limited to six (6) years.

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3. RENTS AND ROYALTIES. As consideration for the granting of this Lease-Option to Lessee, Lessee hereby agrees to pay to the Lessor in the manner as herein provided a percentage royalty based on the value of the "net proceeds" derived from the sale of mineral production of every kind and nature mined and shipped from the aforescribed properties. The percentage royalty paid to the Lessor shall be as follows:

5%- for ores having a "net proceeds" value of \$0.00--\$6.00/ton
6%-for ores having a "net proceeds" value of \$6.00--\$9.00/ton
7%-for ores having a "net proceeds" value of \$9.00--\$12.00/ton
8%-for ores having a "net proceeds" value exceeding \$12.00/ton

In the event that Lessee exercises his option to purchase the aforescribed properties as hereinafter provided, Lessee shall continue to pay to Lessor a production royalty of 2% of the "net proceeds". "Net proceeds" as used herein is defined to be the value of the crude ore at the mouth of the mine. No mining costs shall be deducted from the value in order to determine net proceeds from said crude ore, but all costs incurred after the ore is mined and hoisted to the surface, such as trucking, milling, shipping, smelter charges or any other charges necessary to the sale of the mineral production, shall be deducted from the recoverable value of the crude ore in determining net proceeds value.

Said royalty payments shall be due and payable within thirty (30) days after receipt by Lessee of the money from the sale of said mineral production.

21. OPTION TO PURCHASE. Lessee shall have the right at any time up to six (6) years after the signing date of this agreement to purchase the properties leased hereunder, including any and all surface rights except for certain timber rights, hereinafter defined. During the sixth and final year of the term of this agreement, the purchase price shall be SIX HUNDRED THIRTY EIGHT THOUSAND ONE HUNDRED FORTY DOLLARS (\$638,140). To exercise the OPTION TO PURCHASE, Lessee shall give Lessor notice in writing of its intent to do so. In such event, Lessor will deliver to Lessee within thirty (30) days after receipt hereof, said notice a complete merchantable abstract of title or guaranty policy, or merchantable copy, brought down to date hereof, and Lessee shall have thirty (30) days after receipt hereof, such abstracts within which to specify in writing in detail the objections he makes to the title, if any; or if there be no objections, then stating in substance that the same is satisfactory. In case material defects be found in said title and so reported, then if such defects be not cured within sixty (60) days after such notice thereof, Lessee may take the title as it then is (with the right to deduct from the purchase price liens or encumbrances of a definite or ascertainable amount) or may at his option terminate this agreement; notice of such election shall be given to Lessor within ten (10) days after the expiration of said sixty (60) days.

Lessee, within five (5) days after delivery of said abstract or guaranty policy showing such defects cured or removed, shall pay to the Lessor the balance of the purchase price, provided deed is ready for delivery, and Lessor shall at said time deliver to Lessee a good and sufficient Warranty Deed conveying to Lessee title to said premises (which Warranty Deed shall include a release of dower and waiver of homestead and shall be duly executed and stamped).

23. ADVANCE OR MINIMUM ROYALTIES. Commencing with the signing date of this MINING LEASE WITH OPTION TO PURCHASE and until Lessee exercises his option to purchase or terminates this agreement as herein before provided, Lessee agrees to pay Lessor advance or minimum royalties in the amount of ONE THOUSAND DOLLARS (\$1,000) per month for a period of five (5) years thereafter advance or minimum royalties shall be ONE THOUSAND AND FIVE HUNDRED DOLLARS (\$1,500) per month.

Payment for the first three (3) months that this Lease-Option is to be in effect is to be made within ten (10) days of the signing date of this lease. Thereafter, advance minimum royalty payments shall be made quarterly on each three-month anniversary date, commencing with the signing date of this lease.

2. It is further agreed that all other terms and conditions in the original Mining Lease with Option to Purchase are to remain in force and effect unless in direct contradiction to the changes cited herein.

IN WITNESS WHEREOF, the parties hereto set their hands and seals this 23rd day of February, 1984.

Signed, sealed and delivered
in the presence of:

Ramela R. Robertson

C. M. Tucker, Jr.
C. M. Tucker, Jr.

Alice G. Tucker
Alice G. Tucker

Kenneth C. Smith
Witnessed for Lessors

Dorothy H. Clark
Dorothy Clark

Lessor

Brian W. Hester

Brian W. Hester
Gold Resources, Inc.
By Brian W. Hester, President

Lessee

000009

STATE OF SOUTH CAROLINA)
COUNTY OF CHESTERFIELD)

PROBATE

PERSONALLY Appeared before me Pamela R. Robertson
who being first duly sworn, says that she saw the within named C. M.
TUCKER, JR., ALICE G. TUCKER, DOROTHY H. CLARK, sign, seal, and as their
act and deed deliver the within written Agreement and that she with Eunice Smith
witnessed the execution thereof.

SWORN TO BEFORE ME THIS 23rd
day of February, 19 84.

Pamela R. Robertson

Eunice C. Smith

Doris H. Funderburk
NOTARY PUBLIC FOR SOUTH CAROLINA

My Commission Expires: My Commission Expires April 3, 1988

STATE OF COLORADO)
COUNTY OF EL PASO) SS

On the 14th day of February, 1984, before me a Notary
Public, Personally appeared Brian W. Hester, personally known to me to
be an officer of Gold Resources, Incorporated, a private corporation
described in and which executed the foregoing instrument, and be acknowledged
that he executed the same as an act and deed of Gold Resources, Incorporated.

Laudia K. Gaulton

Notary Public in and for said
County and State
508 Mining Exchange Building
Colorado Springs, CO 80903

My Commission Expires:

5/16/84

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One of the NICOR
basic energy companies

NICOR MINERAL VENTURES

Suite 4200 4949 South Syracuse Street Denver, Colorado 80237 303 694 4936

September 13, 1983

~~Gold Resources, Inc.~~
513 Mining Exchange Building
8 South Nevada Avenue
Colorado Springs, Colorado 80903

Attention: Mr. Brian W. Hester

Re: Brewer Prospect, Chesterfield County, South
Carolina

Gentlemen:

Upon acceptance as provided below by Gold Resources, Inc., a Delaware corporation ("GRI"), this letter will constitute an agreement between GRI and NICOR Mineral Ventures Inc., an Illinois corporation ("NICOR"), with respect to the Brewer Prospect in Chesterfield County, South Carolina.

Pursuant to a Mining Lease with Option To Purchase dated March 28, 1979 (the "Mining Lease"), GRI is the lessee of an approximately 960-acre tract of fee land in Chesterfield County, South Carolina, which is identified in Attachment 1 hereto (the "Subject Property"). Attachment 1 identifies the owners of the Subject Property ("Owners"), all payments due under the Mining Lease, the burdens on production from Subject Property prior to any exercise of the purchase option, the terms of exercise of the purchase option, and burdens on production from the Subject Property after exercise of the purchase option.

NICOR and GRI desire hereby to set forth their agreements with respect to the Subject Property.

1. Title Evaluation.

GRI has delivered to NICOR a copy of the Mining Lease, and copies of all agreements, instruments, abstracts, title opinions and other materials which evidence the status of GRI's title to the Subject Property. GRI also agrees to deliver to NICOR within fifteen (15) days after the date of

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its acceptance hereof ("Acceptance Date") an estoppel certificate in form reasonably satisfactory to NICOR executed by the Owners confirming that the Mining Lease is in full force and effect. NICOR will have thirty (30) days after the Acceptance Date to review such materials and to undertake such other investigations and inquiries as it determines to be warranted in order to satisfy itself with respect to the status of GRI's title to the Subject Property. If, on or before thirty (30) days after the Acceptance Date, NICOR notifies GRI of material defects in GRI's title to the Subject Property, GRI will promptly undertake and diligently pursue efforts to cure such defects as soon as practicable. If GRI has been unable to cure any such defects within thirty (30) days after such notice, it will so notify NICOR. Thereafter, NICOR will promptly elect by notice to GRI either: (i) to enter into the Joint Venture (as defined below) notwithstanding such uncured defects but subject to the warranties in Paragraph 4.3, or (ii) not to enter into the Joint Venture.

2. NICOR Option to Enter into Joint Venture.

From the date hereof until five (5) days after completion of all title investigation and title curative periods, if any, described in Paragraph 1, NICOR will have an exclusive and irrevocable option to enter into a joint venture with GRI with respect to the Subject Property on the terms specified in Paragraph 3 below (the "Joint Venture"). Exercise of such option by NICOR shall be by notice to GRI as provided below. If NICOR fails to exercise such option within the prescribed period, it will promptly return to GRI all materials delivered to NICOR by GRI pursuant to Paragraph 1 above, and thereafter the parties will have no further rights or obligations hereunder.

3. Terms of the Joint Venture.

3.1. Purposes, Parties and Interests.

The purposes of the Joint Venture will be to undertake (i) a drilling, sampling and testing program on and for the benefit of the Subject Property, and (ii), if warranted, the commercial exploitation of the mineral values on the Subject Property in accordance with a feasibility study therefor. The initial interests of the parties to the Joint Venture shall be GRI - 99%; NICOR - 1%. Such interests may be adjusted as provided in Paragraphs 3.8 and 3.9 below.

3.2. Initial Contributions to the Joint Venture.

GRI will contribute to the Joint Venture its interests in the Subject Property and all of its data and information relating thereto. Record title to the Subject Property will be conveyed to NICOR, to be held by it as nominee in trust on behalf of the parties to the Joint Venture so long as the Joint Venture remains in effect. GRI's contribution of the Subject Property shall be by a recordable conveyance in form acceptable to NICOR, containing the title warranties set forth in Paragraph 4.3 below. NICOR will contribute to the Joint Venture as its initial contribution all title information concerning the Subject Property which it has gathered pursuant to Paragraph 1 or otherwise.

3.3. Joint Venture Funding.

All funds necessary to conduct the Exploration Program, as defined below, or to continue the Joint Venture in effect beyond December 31, 1985 in the absence of a feasibility study, as provided in Paragraph 3.9 will be contributed to the Joint Venture by NICOR. Funds to exercise the purchase option for the Subject Property shall be contributed to the Joint Venture by NICOR or GRI, as provided in Paragraph 3.5. All funds necessary to conduct Joint Venture operations shall be contributed by NICOR, and in certain instances by GRI as well, in accordance with their respective interests in the Joint Venture from time to time.

3.4. Joint Venture Management and Operation.

NICOR will be the manager of the Joint Venture and solely responsible for the management and control of all Joint Venture activities and operations, subject to the supervision of a management committee as provided below (the "Management Committee"). As manager of the Joint Venture, NICOR will maintain and preserve the Subject Property and will implement all work programs and projects adopted by the Management Committee. NICOR's sole obligations to GRI shall be (i) to act in a commercially reasonable manner and (ii) to act in good faith to comply with the directions of the Management Committee.

As manager of the Joint Venture's activities, NICOR will be entitled to charge the Joint Venture the following amounts as a fee for its general administration and overhead expenses. Such fee shall be in addition to all expenses incurred by NICOR for or in connection with its employees

assigned specifically to the Joint Venture's projects and other out-of-pocket expenses incurred by NICOR for Joint Venture activities ("Direct Costs").

Exploration Activity	5% of Direct Costs
Development Activity	5% of Direct Costs
Production Activity	As reasonably allocated by NICOR, but not to exceed 5% of Direct Costs of such activity
Marketing Activity	As reasonably allocated by NICOR, but not to exceed 5% of Direct Costs of such activity

NICOR, in its sole reasonable discretion, will determine the relevant category of Joint Venture activity for purposes of determining the appropriate rate of overhead and administration charges.

Except as provided to the contrary herein, the activities of the Joint Venture will be directed by a Management Committee composed of four members, with two members appointed by each of the parties. A quorum will consist of at least one representative of each party. One of the members appointed by NICOR shall serve as chairman. The Management Committee shall meet not less often than semiannually, but may meet more frequently as the parties may mutually agree, and may be required to meet not more often than quarterly at the request of either party. Except as expressly provided herein to the contrary, the Management Committee shall be responsible for the direction and supervision of the Joint Venture's activities, including adoption of programs and budgets for commercial development; determining the nature, extent and timing of development and production operations on the Subject Property. The Management Committee shall not have any authority to direct the Exploration Program, which shall be conducted by NICOR as it determines to be appropriate in its sole discretion and NICOR will be solely responsible for selecting the contractors and consultants to be utilized, if any, in connection with Joint Venture activities.

The Management Committee will act by unanimous vote, provided, however, that if a unanimous vote is not attained on a matter under consideration, NICOR as manager will convene an additional meeting of the Management Committee to consider the matter. At such additional meeting, NICOR will submit a modified proposal pursuant to which NICOR will have, in good faith, attempted to take into consideration, to the extent

reasonably possible, any reasonable suggestions and objections expressed in connection with the initial vote. After presentation and discussion, such modified proposal shall be deemed to have been adopted without a further vote. Notwithstanding the foregoing, the Management Committee will not make any determination regarding whether or not to participate with third parties in the development or operation of the Subject Property (with a resultant dilution of the Joint Venture's interests in the Subject Property or production therefrom) or whether to borrow funds for Joint Venture operations and to secure payment thereof by liens or encumbrances on the Subject Property or improvements thereon or production therefrom without the unanimous affirmative vote of the Management Committee.

3.5. Maintenance and Acquisition of the Subject Property.

As manager of the Joint Venture, NICOR will insure that the monthly advance or minimum royalty payments contemplated by Paragraph 23 of the Mining Lease are made in a timely manner. NICOR will contribute to the Joint Venture monthly an amount sufficient to make all such payments. Amounts so contributed by NICOR will constitute a portion of NICOR's Exploration Program obligations.

At any time during the term of the Joint Venture, either party may, by notice to the other, elect to have the Joint Venture exercise the purchase option in the Mining Lease. If GRI has elected to have the Joint Venture exercise the purchase option, it will contribute to the Joint Venture funds sufficient to permit the Joint Venture to pay to the Owners the exercise price. If NICOR has elected to have the Joint Venture exercise the purchase option, GRI will be given an opportunity to contribute to the Joint Venture funds sufficient to exercise the purchase option, and if it fails to do so within ten (10) days after notice of NICOR's election, NICOR will contribute such funds. Funds contributed by either party to the Joint Venture for purposes of exercising such purchase option are referred to herein as the "Acquisition Contribution."

3.6. Exploration, Sampling and Testing Program.

Pursuant to the Joint Venture, NICOR agrees to conduct an exploration, sampling and testing program (the "Exploration Program") on or for the benefit of the Subject Property. NICOR will ensure that written monthly reports of

program activities are given to GRI. The program may be terminated by NICOR at any time after the \$50,000 drilling and sampling activities described below have been completed. Any minerals or other products recovered during such program shall be assets of the Joint Venture, to be used in NICOR's discretion to fund Joint Venture activities or to be distributed to the parties as their Joint Venture interests appear at the time of such distribution.

Commencing as soon as practicable after the effective date of the Joint Venture, NICOR will commence the Exploration Program. The initial stage of such program shall consist of exploratory drilling on the Subject Property and analysis of the results thereof at a cost of not less than \$50,000. Thereafter NICOR may elect to conduct additional activities which may include a metallurgical testing program evaluating recovery of mineral values from material extracted from the Subject Property. If the foregoing program activities have been undertaken by NICOR prior to March, 1984, at a total cost of not less than \$75,000, NICOR may continue Exploration Program activities on or for the benefit of the Subject Property during 1984. If the aggregate cost of such program activities during 1983 and 1984 is not less than \$225,000, and if the Joint Venture's interests in the Subject Property are still in effect, NICOR may continue the Exploration Program on or for the benefit of the Subject Property after 1984, but no minimum expenditure level shall be applicable with respect to such continued activities.

For purposes of valuing program activities, NICOR will include all actual expenses thereof to the Joint Venture, including by way of example and not limitation, all out-of-pocket expenses, of whatever kind or nature, incurred by NICOR for third-party contractors and consultants; all expenses of NICOR employees assigned to program activities, including salaries, travel and benefits; costs of equipment and services supplied by NICOR at cost; bonding and permitting expenses; minimum royalty payments; legal expenses; title confirmation and curative expenses; mapping and geological and literature survey expenses; sampling, assaying and metallurgical testing expenses; project and program design activities; road and access expenses and costs of obtaining necessary power, water and waste disposal facilities. The parties expressly agree that all costs to NICOR of maintaining the Joint Venture's interests in the Subject Property (including any rental, minimum royalty and other payments made by NICOR), charges for general administration and overhead pursuant to Paragraph 3.4 above and all costs of preparing any

feasibility study or studies shall be included for purposes of valuing program activities.

3.7. Duration of Exploration Program.

The Exploration Program will continue until the first to occur of the following events:

(a) termination of the program by NICOR after completion of program activities having a minimum value of \$50,000 as permitted in Paragraph 3.6 above; or

(b) termination of the Joint Venture by GRI because of NICOR's failure to comply with the minimum Exploration Program expenditure levels schedule set forth in Paragraph 3.6; or

(c) the mutual agreement of the parties to terminate the Exploration Program; or

(d) compliance by NICOR with the program value schedule described in Paragraph 3.6 above; or

(e) termination of the Joint Venture because neither NICOR nor GRI has elected to exercise the purchase option specified in the Mining Lease.

3.8. Adjustment of Joint Venture Interests.

If the Exploration Program is terminated pursuant to subparagraphs 3.7(a), (b), (c), or (e) above, the initial interests of the parties in the Joint Venture shall remain unchanged and the Joint Venture will terminate as provided in Paragraph 3.11 below. If the Exploration Program is terminated pursuant to subparagraph 3.7(d) above, the Joint Venture will remain in effect in accordance with its terms and the interests of the parties in the Joint Venture will remain unchanged until NICOR has prepared and delivered a feasibility study (as provided in Paragraph 3.9) showing a basis for commercial operations on the Subject Property, at which time the interests of the parties in the Joint Venture will automatically be adjusted as follows:

(a) If NICOR has made the Acquisition Contribution, the interests of the parties in the Joint Venture will be NICOR - 85%; GRI - 15%. GRI will have no obligation to make any contributions to the Joint Venture for costs of operations or otherwise by reason of such 15%

interest but, subject to Paragraph 3.10 below, it will receive 15% of the net revenues from Joint Venture operations. The interest of GRI in the Joint Venture will be subject to modification at GRI's option pursuant to Paragraph 3.9 below.

(b) If GRI has made the Acquisition Contribution, (i) the interests of the parties in the Joint Venture will be NICOR - 85%; GRI - 15% and GRI will have no obligation to make any contribution to the Joint Venture by reason of such 15% interest but, subject to Paragraph 3.10 below, it will receive 15% of the net revenues from Joint Venture operations; and (ii) GRI will have the right to acquire up to an additional 20% cost-bearing interest in the Joint Venture as provided in Paragraph 3.9.

3.9. Feasibility Study; GRI Election.

In the event that NICOR makes a determination that an attempt should be made by the Joint Venture to place the Subject Property into production, a feasibility study for such project will be prepared by NICOR and a copy thereof will be submitted to GRI. Such feasibility study shall describe a program for construction and operation of a commercial production project on the Subject Property and will include (i) an estimate of the nature and grades of mineral reserves, (ii) an estimate of the magnitude and timing of costs of implementing such program, and (iii) the estimated timing and magnitude of revenues from such project. It is expressly agreed that the Management Committee may modify such study and program, or terminate it, if changing circumstances reasonably warrant such action. It is further agreed that NICOR will be solely responsible for establishing the nature and timing of any program for implementing the feasibility study, although NICOR will be obligated to act in a commercially reasonable manner with respect thereto.

Subject to the further provisions hereof, NICOR will cause such feasibility study to be prepared by not later than December 31, 1985, provided however that if by December 31, 1985 NICOR has contributed \$25,000 to the Joint Venture and caused such amount to be distributed to GRI, NICOR shall have until December 31, 1986 to prepare such feasibility study. In like manner NICOR may extend from year to year the date by which such feasibility study must be prepared by causing an annual cash distribution to be made to GRI prior to each succeeding December 31. The amount of such distribution shall for each year be fifty percent (50%) greater than the distribution in the prior year. Thus, for example, the

distribution prior to December 31, 1986, if any, would be \$37,500 and the distribution prior to December 31, 1987, if any, would be \$56,250. All amounts so distributed to GRI will be a credit against and will reduce any distributions to GRI pursuant to Paragraph 3.10.

If GRI has made the Acquisition Contribution, upon receipt of such feasibility study GRI will have a right to elect, by notice to NICOR, to acquire an additional 5%, 10%, 15% or 20% cost-bearing interest in the Joint Venture. Such election shall be made by GRI by notice to NICOR as soon as practicable, but in all events not more than 90 days after receipt of the feasibility study. If GRI elects to so modify its Joint Venture interest, the additional interest elected by GRI will be referred to as the "Increased Interest." Within thirty days after its election to acquire the Increased Interest, GRI will contribute to the Joint Venture, for immediate disbursement to NICOR, an amount equal to a percentage of NICOR's total expenditures in connection with the Exploration Program and any other Joint Venture activities which is equal to the percentage Increased Interest elected by GRI; i.e., if GRI has elected a 10% Increased Interest, it will contribute to the Joint Venture 10% of NICOR's total expenditures, provided, however, that GRI may deduct from such amount the amount of the Acquisition Contribution. If GRI fails to notify NICOR of its election in a timely manner, GRI will have elected not to increase its Joint Venture interest. Any such increase in GRI's Joint Venture interest will result in a corresponding reduction in NICOR's Joint Venture interest.

If GRI holds a cost-bearing interest in the Joint Venture pursuant to this Paragraph 3.9, it shall contribute to the Joint Venture within thirty (30) days after invoice by NICOR funds to pay expenses allocated to such interest. If GRI fails to make any such contribution, NICOR shall advance such funds on GRI's behalf. Any such advance shall constitute a loan by NICOR to GRI, which at the request of NICOR shall be evidenced by a promissory note. Any such loan shall bear interest at the per annum prime rate quoted from time to time by the Northern Trust Company, plus one percent (1%). If such loan and accrued interest is not repaid within thirty (30) days after being made by NICOR, GRI will automatically relinquish to NICOR all of its rights to receive income and distributions from the Joint Venture (pursuant to the Increased Interest and otherwise). NICOR shall be credited with all of GRI's share of such income and distributions until NICOR shall have received one hundred

percent (100%) of the amount advanced, plus interest, together with an additional fifty percent (50%) of the amount advanced as liquidated damages. Upon receipt of such amounts by NICOR the relinquished interest shall automatically revert to GRI. Because actual damages arising out of GRI's failure to make the contributions required by this Paragraph 3.7 are virtually impossible to estimate accurately, especially when viewed in the light of the increased risk and financial exposure to NICOR which may result from a failure to make such payments, the parties agree that the provision for liquidated damages in an amount equal to fifty percent (50%) of any amount so advanced by NICOR is reasonable and not disproportionate to potential actual damages. This provision is not a penalty, but is intended by the parties to promote performance and to adjust in advance damages that are to be recovered in the event of failure to pay amounts due.

3.10. Allocation and Distribution of Net Proceeds.

Net proceeds of Joint Venture operations shall be allocated as follows:

(i) eighty percent (80%) of such net proceeds will be allocated to NICOR, or, if GRI has an Increased Interest, such eighty percent of net proceeds shall be divided into portions in accordance with the following table and such portions allocated to NICOR and GRI respectively until the amounts so allocated to NICOR equal 126% of NICOR's unreimbursed Exploration Program costs, and all other costs incurred by NICOR in connection with the Joint Venture and until the amounts so allocated to GRI equal 126% of GRI's Acquisition Contribution and costs of acquisition of its Increased Interest.

<u>GRI Increased Interest</u>	<u>GRI Allocation</u>	<u>NICOR Allocation</u>
5%	4%	76%
10%	8%	72%
15%	12%	68%
20%	16%	64%

(ii) twenty percent (20%) of such net proceeds will be allocated between NICOR and GRI as their interests in the Joint Venture appear.

The allocations to GRI pursuant to (i) and (ii) above will be relinquished to NICOR in the circumstances described in Paragraph 3.9 above.

In the event either party recovers 126% of its described expenses pursuant to paragraph (i) above prior to such recovery by the other party, such party's allocation pursuant to paragraph (i) shall terminate, and funds which would have been allocated to such party pursuant to such paragraph (i) will be allocated to both parties pursuant to paragraph (ii) above.

Proceeds from Joint Venture operations will be distributed to the parties from time to time when reasonably determined by NICOR to be available for distribution. NICOR agrees to review the status of Joint Venture revenues and expenses not less often than quarterly after commercial production has commenced and, if possible, to distribute revenues which exceed reasonably anticipated expenses for the following quarter. Any party may elect to receive its share of such distributions in kind in minerals recovered in Joint Venture operations, but such party shall alone bear any increased costs to the Joint Venture in so delivering such products in kind.

3.11. Term and Termination of Joint Venture.

The Joint Venture will remain in effect until the first to occur of the following:

- (i) the mutual agreement of the parties to terminate the Joint Venture;
- (ii) termination of the Joint Venture's interests in the Subject Property;
- (iii) an election by NICOR to terminate the Exploration Program prior to compliance with the value schedule specified in Paragraph 3.6 or the failure of NICOR to comply with the value schedule in Paragraph 3.6;
- (iv) an election of NICOR to surrender its interests in the Subject Property; or
- (v) the failure of NICOR to prepare a feasibility study by December 31, 1985, or by each

December 31 thereafter without having caused an annual payment to be made to GRI as provided in Paragraph 3.9 above.

If the Joint Venture is terminated prior to the adjustment in the parties' interests pursuant to Paragraph 3.8 above, all Joint Venture assets will be distributed exclusively to GRI. In such case the Subject Property will be reconveyed by NICOR to GRI free and clear of any liens, burdens or defects created or suffered by NICOR. If the Joint Venture is terminated after such adjustment of the parties' interests, undivided interests in the Joint Venture assets will be distributed to GRI and NICOR as their Joint Venture interests appear at the time of termination.

3.12. Area of Mutual Interest.

The parties to the Joint Venture will be subject to an area of mutual interest covering all lands within two kilometers of any portion of the Subject Property. Any interests acquired by any party within the Area of Mutual Interest after the date hereof and while the Joint Venture is in effect shall be committed to the Joint Venture at the election of the non-acquiring party, subject to its reimbursement of one-half of the acquiring party's acquisition expenses.

3.13. Preferential Purchase Right.

If either party desires to sell or transfer (other than in connection with a merger or consolidation or transfer to a parent or wholly-owned subsidiary) its interests in the Joint Venture and the properties subject thereto, if applicable: (i) any such interest shall not be subdivided but shall be sold or transferred in its entirety only to a single purchaser or transferee; and (ii) such interest shall not be sold or transferred until the other party hereto has been given the first opportunity to purchase such interest at the proposed sale or transfer price and has not acted to exercise such opportunity within sixty days after notice from the selling or transferring party.

3.14. Relationship of the Parties.

The liabilities of the parties shall be several and individual, not joint. No party shall be liable for the expenses, costs or liabilities of another party, except as

expressly provided to the contrary herein. Solely for purposes of federal income tax matters, the Joint Venture will be a partnership; all items of income tax loss, expense, deduction, and credit shall be allocated to the party contributing funds to the Joint Venture giving rise thereto; and NICOR will prepare all tax forms and make all tax elections on behalf of the Joint Venture.

3.15. Access.

Subject to reasonable prior notice to NICOR, GRI shall have full and free access to the Subject Property, all Joint Venture operations thereon or related thereto, and to all data, books and records gathered or maintained by NICOR with respect thereto.

3.16. Encumbrances.

Neither party will create or suffer a lien or encumbrance on its interests in the Joint Venture or Subject Property without the prior consent of the other party, except that if the interest of NICOR is 80% or more, NICOR will be free to encumber its interest without GRI's consent.

4. General Provisions.

4.1. Notices.

Notices and deliveries of information will be in writing and effective upon receipt after transmission by United States mail, postage prepaid, addressed to the parties at the addresses set forth above.

4.2. Confidentiality.

Information regarding this Agreement, the Joint Venture, the Subject Property, and operations of the parties on or with respect to the Subject Property is confidential and will not be disclosed to third parties without the prior consent of the non-disclosing party, which will not be withheld unreasonably, except:

- (i) to consultants, contractors and potential participants in the project; or
- (ii) potential purchasers or providers of funding for the project; or

(iii) as required by law.

In connection with any disclosure, the disclosing party shall take reasonable steps to preserve the confidentiality of the information disclosed.

4.3. GRI Representations and Warranties.

GRI represents and warrants that (a) it has all requisite power and authority to enter into this Agreement and to perform its obligations hereunder; (b) it has taken all requisite action to authorize the execution and delivery of this Agreement and the performance of all its obligations hereunder; (c) it is not a party to or bound by, nor is the Subject Property or any portion thereof subject to, any agreement or instrument of any kind, or any judgment, order, writ or injunction of any court or governmental body that would prohibit or adversely affect the carrying out of any of GRI's obligations hereunder; (d) GRI owns legal title to the entire leasehold estate and other rights and interests created by the Mining Lease; and (e) except as specified in Attachment 1, the Subject Property is free of any mortgages, deeds of trust, security agreements, liens, royalties, overriding royalty interests, burdens or encumbrances of any kind.

4.4. Successors and Assigns.

This agreement is binding on the successors and assigns of the parties hereto. No assignment hereof will be effective until the assignee has agreed in writing to the terms hereof and such agreement has been delivered to the non-assigning party. No such assignment shall relieve the assigning party of its obligations hereunder unless the non-assigning party so consents in writing.

4.5. Force Majeure.

The obligations of either party hereunder, except the obligation to pay or contribute funds, will be suspended and the time for performance extended where such performance is prevented or made impracticable by events, occurrences or laws beyond such party's control.

4.6. Definitive Agreement.

Upon acceptance, this constitutes a binding agreement between the parties, enforceable in accordance with its terms. Nevertheless, but not as a condition to the binding

Gold Resources, Inc.
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nature hereof, at any time upon the request of either party to the other, the parties agree to prepare a definitive agreement more fully setting forth their agreements and understandings, and to use their best efforts to execute such agreement as soon as practicable after such request.

Please indicate your acceptance hereof by executing and returning a copy prior to September 20, 1983.

NICOR MINERAL VENTURES INC.

By 

Agreement confirmed this
28th day of September,
1983.

GOLD RESOURCES, INC.

By 

Attachment 1: Subject Property

MINING LEASE WITH OPTION TO PURCHASE

THIS AGREEMENT, made and entered into this 28th day of March, 1979, by and between C. M. Tucker, Jr., and Alice G. Tucker, his wife, of Pageland, South Carolina, and Dorothy H. Clark, a widow, never having remarried, of Jefferson, South Carolina hereinafter referred to as "Lessor" and Gold Resources Inc., a corporation organized under the laws of Delaware, having it's principal place of business at 345 Park Ave., New York, New York 10022, hereinafter referred to as "Lessee".

WITNESSETH:

Lessor, for and in consideration of the payments of the rents and royalties and the preformance of the covenants, terms and conditions set forth by Lessee to be paid, kept, and performed, does by these presents grant, lease and option to said Lessee all those certain properties, minerals and mining rights belonging to Lessor, situated in Chesterfield County, State of South Carolina, to wit:

All that certain piece, parcel or tract of land situate, lying, and being in the County of Chesterfield, State of South Carolina, near the town of Jefferson, South Carolina, known as the "Brewer Mine", containing 1,000 acres more or less, the said property being more particularly described in "Exhibit A", attached hereto and made a part of hereof.

NOW THEREFORE, in consideration of the sum of ONE DOLLAR (\$1.00) and other valuable consideration paid or to be paid by the Lessee to the Lessor, and the mutual covenants to be kept and performed by the parties hereto as hereinafter expressed, the Lessor hands and by these presents do give and grant to said Lessee the exclusive right to enter upon said premises for the purpose of removing said minerals and mineral substances, erecting buildings to be used in connection, either directly or indirectly, with the operations of Lessees upon the above premises, installing machinery, tipples, sinking shafts, drifting, drilling, stripping, removing overburden or using any and all methods known to the science of mining, milling refining or otherwise preparing ore minerals and mineral substances for market and the exclusive right to so conduct prospecting, mining, milling and related operations upon the described premises, together with the right of ingress and egress and to build and construct over and across said lands, roads, trams and other means of conveyance for the purpose of transporting ore, minerals or other valuable mineral substances found thereon or thereunder, together with the right to use any water found on the property for any use related to the aforementioned purposes.

1. TITLE OF LESSOR. Lessor warrants and represents that he is the sole and exclusive owner of said mining properties free and clear of any right or claim of any other person whatsoever, and that each and all of said claims and rights of Lessor as owner are now valid and subsisting.

In the event the Lessee is required to make any payment to any person or persons or to pay any reasonable legal fees in connection with perfection of title of Lessor to said mining properties, said sum shall be deducted from any amounts due Lessor under the terms of this lease. If Lessor owns a less interest in the above described land or any part thereof than the entire and undivided mineral estate, then the royalties and other consideration herein provided for shall be paid to the Lessor only in the portion which his interests bear to the whole and undivided fee of that portion of the leased premises from which the ore is extracted.

Lessor represents that he has not done or suffered anything whereby the said premises have been encumbered in any way whatsoever and that to the best of his knowledge the said mining properties are free and clear from any right or claim of any other person.

Both Lessor and Lessee agree that this MINING LEASE WITH OPTION TO PURCHASE supercedes and takes the place of a previous MINING LEASE WITH OPTION TO PURCHASE dated March 28, 1973, a memorandum of which was recorded on July 6, 1973 in deed book 225, page 675 in the office of the Clerk of the Court, Chesterfield County, Chesterfield, South Carolina, and also supercedes and takes the place of all subsequent amendments to that MINING LEASE WITH OPTION TO PURCHASE.

2. TERM. The term of this lease-option shall be for a period of five (5) years from the date hereof. The lease may be extended one additional year so long as Lessee continues to mine or develop and pays the royalties as hereinafter provided, it being specifically understood the term of the option is limited to five (5) years.

3. RENTS AND ROYALTIES. As consideration for the granting of this Lease-Option to Lessee, Lessee hereby agrees to pay to the Lessor in the manner as herein provided a percentage royalty based on the value of the "net proceeds" derived from the sale of mineral production of every kind and nature mined and shipped from the aforescribed properties. The percentage royalty paid to the Lessor shall be as follows:

5%-for ores having a "net proceeds" value of \$0.00--\$ 6.00/ton
6%-for ores having a "net proceeds" value of \$6.00--\$ 9.00/ton
7%-for ores having a "net proceeds" value of \$9.00--\$12.00/ton
8%-for ores having a "net proceeds" value exceeding \$12.00/ton

In the event that Lessee exercises his option to purchase the aforescribed properties as hereinafter provided, Lessee shall continue to pay to Lessor a production royalty of 1% of the "net proceeds". "Net Proceeds" as used herein is defined to be the value of the crude ore at the mouth of the mine. No mining costs shall be deducted from the value in order to determine net proceeds from said crude ore, but all costs incurred after the ore is mined and hoisted to the surface, such as trucking, milling, shipping, smelter charges or any other charges necessary to the sale of the mineral production, shall be deducted from the recoverable value of the crude ore in determining net proceeds value.

Said royalty payments shall be due and payable within thirty (30) days after receipt by Lessee of the money from the sale of said mineral production.

4. RECORDS. Lessee agrees to keep a full, true and accurate record showing the tonnage and all shipments and sales of all minerals, metals and other production from the said mining properties and receipts therefrom in connection therewith, which books, records and accounts may be inspected by Lessor at any reasonable time.

5. MINING OPERATIONS. Lessee further agrees to perform all mining operations in a good and workmanlike manner, to properly and adequately timber where necessary all shafts, tunnels and all underground excavations for the safety of the workmen and the preservation of said premises as a mine in a manner commensurate with good and economical mining.

6. RESERVATION OF TITLE TO EQUIPMENT. It is agreed that the title to all mining machinery, equipment, fixtures and structures erected or placed upon said mining claims and premises by Lessee shall be reserved to said Lessee and remain the personal property of Lessee, subject to removal at his will and pleasure during the continuance of this lease and ninety (90) days thereafter, irrespective of the manner or method of attachment to said real property; provided, that such right of removal shall not extend to foundations or mined timbers in place, unless Lessor shall have given his written consent thereto. If Lessee is hampered by snowdrifts, washouts, inclement weather, or other climatic conditions from completing removal of said items within the specified time, then Lessor agrees to extend the time by a reasonable period if required by Lessee.

7. INSURANCE. Lessee hereby agrees to carry adequate workmen's compensation insurance for the protection of all workmen employed on said premises and claims or in the mining operations. Lessee further agrees at all times during the term of this lease to carry \$300,000 of public liability insurance for injury to persons and \$100,000 of property damage insurance for property damaged on the premises.

8. TERMINATION. Lessee may cancel or terminate this lease upon ten (10) days' notice in writing to that effect mailed to Lessor as provided under "Notice" at any time during the life of this lease. In the event of such termination, Lessee shall have the right to abandon his operation of the mining properties without the payment of any further sums, except rents and royalties required to be paid before expiration of said notice and without further penalty to the Lessee and sums of money paid to the Lessor prior to such termination shall be accepted by the Lessor and received by him in full and complete payment of all claims of every kind and nature which the Lessor may have against the Lessee.

9. DEFAULT. If Lessee fails, neglects or refuses to pay the rents and royalties as herein provided, or fails or neglects to perform the other terms, covenants, or other conditions or any part thereof, as herein provided, and such default continues for thirty (30) days after notice to Lessee in writing to rectify such default, Lessor or his agents may re-enter and take possession of said mining claims and premises and may remove all persons found thereon and thereupon this agreement and lease shall be forthwith terminated and all payments of every kind theretofore made to Lessor shall be retained as rental for the use and occupation of said premises by Lessee, and thereupon within ninety (90) days Lessee shall remove his personal property and other property from said premises, provided that any such notice of default sent by Lessor to Lessee must be signed by the Lessor or by the attorney for the Lessor.

10. ASSIGNMENT. This MINING LEASE WITH OPTION TO PURCHASE may be assigned in whole or in part by Lessee and upon such assignment the assignee shall be solely responsible to Lessor for such assignee's pro rata portion of any or all of the obligations or liabilities under this agreement, and Lessee shall proportionately be relieved of any or all of said obligations or liabilities. After Lessee makes his first assignment of his rights hereunder, Lessor shall have the right to disapprove of any subsequent sublessee.

11. NOTICE. Any notice to be given to Lessor or any payments to be sent to Lessor, as provided herein, shall be sent by registered mail to:

C. M. Tucker and Dorothy Clark
P. O. Box #7
Pageland, South Carolina 29728

or at such other address or addresses as he respectively may hereafter designate in writing from time to time. The above named shall serve as agent for Lessor and shall receive and distribute royalties to the Lessors.

12. COMPLIANCE WITH STATE LAWS. Lessee agrees that he will operate said mine in full compliance with all state mining laws.

13. CHANGES. None of the covenants, terms or conditions of this agreement shall in any manner be altered, waived, changed, or abandoned, except by a written instrument signed by the parties hereto.

14. LIABILITY AND NON-RESPONSIBILITY. Lessee shall pay, as due, all valid claims for work done, services rendered, or material furnished to the leased premises and shall hold Lessor harmless from any liability arising out of any operations under the lease. Lessee shall defend all suits or claims arising out of such operations at his own expense. Lessee agrees to post notice of non-responsibility signs upon the property for the protection of the Lessor.

15. FORCE MAJEUR. In the event the Lessee is prevented from performing this agreement by fires, floods, explosions, riots, any unusual mining casualties, acts of God, government restriction of orders, suspension of buying by the government where no commercial market is available, severe weather conditions or other extraordinary events beyond his control, then the time of performance of this agreement by Lessee shall be suspended during the continuance of such acts which prevent performance, it being specifically understood that such events shall not affect or forgive any payments which may be due to the Lessor and such events shall not extend the option to purchase beyond five (5) years.

16. TRANSFERABILITY. This agreement shall be binding upon and inure to the benefit of the heirs, administrators, executors, assigns and successors in interest of either Lessor or Lessee.

17. TAXES. Lessee shall pay all state and county tax assessments upon any and all structures and other improvements, machinery, equipment, tools supplies, and personal property whatsoever placed upon the leased premises by the Lessee. Lessee shall also pay all state and county "net proceeds" or production taxes assessed against Lessee and other taxes assessed against Lessee on account of his operations hereunder. Lessor shall pay all state and county net proceeds or production taxes assessed against Lessor on account of his receipt of rents and royalties of whatever nature provided herein to be paid to Lessor by the Lessee.

18. INSPECTION OF PREMISES. Lessor or his agents may at all reasonable times and at Lessor's risk enter upon and into the leased premises for inspection and to conduct survey or sampling operations; provided, that such activities shall not unreasonably interfere with the operations of the Lessee.

19. NUMEROUS LESSORS. If at any time five parties or more are entitled to receive royalties under this lease, Lessee may withhold payment until all parties designate in writing a trustee to receive all royalty payments and to execute division and transfer orders for those entitled to royalties. The writing must be recordable, binding upon heirs and successors in title, and filed with the Lessee.

20. PARTIES. Whenever in this agreement the masculine gender is used, it shall include the feminine gender, and the singular shall include the plural.

21. OPTION TO PURCHASE. Lessee shall have the right at any time up to five (5) years after the signing date of this agreement to purchase the properties leased hereunder, including any and all surface rights except for certain timber rights, hereinafter defined. During the first year of the term of this agreement, the purchase price shall be FIVE HUNDRED THOUSAND DOLLARS (\$500,000) and said purchase price shall be increased by FIVE PERCENT (5%) on each succeeding annual anniversary date as long as the agreement is in force and effect, as shown on "Exhibit B" attached hereto and made a part hereof. To exercise the OPTION TO PURCHASE, Lessee shall give Lessor notice in writing of its intent to do so. In such event, Lessor will deliver to Lessee within thirty (30) days after receipt hereof, said notice a complete merchantable abstract of title or guaranty policy, or merchantable copy, brought down to date hereof, and Lessee shall have thirty (30) days after receipt hereof, such abstracts within which to specify in writing in detail the objections he makes

to the title, if any; or if there be no objections, then stating in substance that the same is satisfactory. In case material defects be found in said title and so reported, then if such defects be not cured within sixty (60) days after such notice thereof, Lessee may take the title as it then is (with the right to deduct from the purchase price liens or encumbrances of a definite or ascertainable amount) or may at his option terminate this agreement; notice of such election shall be given to Lessor within ten (10) days after the expiration of said sixty (60) days.

Lessee, within five (5) days after delivery of said abstract or guaranty policy showing such defects cured or removed, shall pay to the Lessor the balance of the purchase price, provided deed is ready for delivery, and Lessor shall at said time deliver to Lessee a good and sufficient Warranty Deed conveying to Lessee title to said premises (which Warranty Deed shall include a release of dower and waiver of homestead and shall be duly executed and stamped).

22. RESERVATION OF TIMBER. It is agreed by Lessor and Lessee that Lessor shall retain the right to all marketable timber until one year after such time that Lessee may exercise his option to purchase as hereinabove provided.

23. ADVANCE OR MINIMUM ROYALTIES. Commencing with the signing date of this MINING LEASE WITH OPTION TO PURCHASE and until Lessee exercises his option to purchase or terminates this agreement as herein before provided, Lessee agrees to pay Lessor advance or minimum royalties in the amount of ONE THOUSAND DOLLARS (\$1,000) per month.

Payment for the first three (3) months that this Lease-Option is to be in effect is to be made within ten (10) days of the signing date of this lease. Thereafter, advance minimum royalty payments shall be made quarterly on each three-month anniversary date, commencing with the signing date of this lease.

24. CREDIT AGAINST FUTURE PRODUCTION. It is understood that any advance or minimum royalty shall be credited to earned royalty, and earned royalty shall be credited to minimum royalty during the year, but no minimum royalty payment shall be credited to earned royalty, other than for the year in which said minimum royalty is paid.

25. TECHNICAL INFORMATION. If Lessee abandons or terminates this agreement, Lessee agrees to furnish to Lessor copies of the basic technical data generated as a result of his work, without interpretation or any liability to Lessee for its subsequent use.

26. WORK REQUIREMENTS. Lessee agrees that in order to keep this MINING LEASE WITH OPTION TO PURCHASE in force and effect he will spend or cause to be spent for each lease year FIFTY THOUSAND DOLLARS (\$50,000) for exploration or development on the properties covered herein. Any amounts spent in excess of FIFTY THOUSAND DOLLARS in any lease year may be applied to work requirements in subsequent years.

IN WITNESS WHEREOF, the parties hereto have executed this MINING LEASE WITH OPTION TO PURCHASE the day and year first hereinabove written.

Signed, sealed and delivered
in the presence of:

Nancy S. Levenson

C. M. Tucker, Jr.
C. M. Tucker, Jr.

Billy B. Levenson

Alice G. Tucker
Alice G. Tucker

Ellen H. Sunderbuck
Witness for Lessor

Dorothy M. Clark
Dorothy M. Clark

Orin P. McKee
Witness for Lessee

Gold Resources, Inc.
Gold Resources, Inc.

By: Robert M. Clark

Title: Pres.

STATE OF SOUTH CAROLINA)
COUNTY OF CHESTERFIELD)

PROBATE

PERSONALLY appeared before me Billy G. Lowery who
being first duly sworn, says that she saw the within named C. M.
Tucker, Jr., Alice G. Tucker, Dorothy M. Clark, sign, seal and as
their act and deed deliver the within written Agreement and that
she with Nancy B. Lowery witness the execution thereof.

SWORN to before me this 15
day of March, 1979

Billy G. Lowery

Diane H. Furdick
NOTARY PUBLIC FOR SOUTH CAROLINA

My Commission Expires: 4-3-88

STATE OF NEW YORK)
COUNTY OF NEW YORK)

On the 28th day of March, 1979 before me a Notary Public
personally appeared Gordon P. Reed personally known to
me to be President of Gold Resources, Inc.,
the Corporation described in and which executed the foregoing
instrument, and he acknowledged that he executed the same as
an act and deed of Gold Resources, Inc.

ELVA B. MOORE
Notary Public, State of New York
No. 41-4505209
Qualified in Queens County
Commission Expires March 30, 1979

Elva B. Moore
Notary Public for said County
and State

My Commission Expires:

"EXHIBIT A"

All that certain piece, parcel or tract of land situate, lying and being in the County of Chesterfield, State of South Carolina, near the town of Jefferson, South Carolina, known as the "Brewer Mine", containing 1,000 acres, more or less, said property being more particularly described and bounded as follows, to wit: starting at a point on the northwest side of the intersection of Highways S.C. 265 and S.C. 110; thence along S.C. 110, north 21 degrees west, 411 feet; then north 34 degrees west 289 feet; then north 40 degrees west 1,500 feet; then north 46 degrees west 150 feet; then north 57 degrees west 200 feet; then north 68 degrees west 177 feet; then north 80 degrees west 212 feet; then south 88 degrees west 157 feet to the line of the property now or formerly owned by Robert Raley; then generally north 25 degrees west 3,341 feet along said property line to an iron at the corner of property now or formerly of Hilton and property now or formerly of McLaughlin; then turning and running in a generally northeasterly direction along property now or formerly of McLaughlin for a total distance of 1,300 feet to a point at the corner of an old cemetery; then turning and running in a generally northwesterly direction along property now or formerly of McLaughlin and Joe Thomas for a total of 2,777 feet to a point 976 feet from Lynches River; then turning and running in a generally northeasterly direction along property now or formerly of C. M. Tucker Jr.; for a total distance of 1,635 feet to some rocks; then turning and running in a generally northerly direction along property now or formerly of C. M. Tucker Jr. for a total distance of 1,873 feet to some rocks; then turning and running in a generally northeasterly direction for a total distance of 1,981 feet to a pine; then turning and running in a generally southeasterly direction along property now or formerly of Mrs. Ruth Gregory for a total distance of 3,049 feet to a rock on Little Fork Creek; then turning and running in a generally southeasterly direction along a line, Little Fork Creek for a total distance of 574 feet to a point on the said creek; then turning and running in a generally southeasterly direction for a total distance of 800 feet to a point on said creek; then turning and running along the line of Little Fork Creek for a total distance of 4,532 feet to a point; then turning and running in a generally southeasterly direction for a total distance of 625 feet to a birch tree; then turning and running in a generally southwesterly direction along property now or formerly of the Attie Gay Estate for a total distance of 2,083 feet to a white oak where said property adjoins that of Evelyn Reid; then turning and running in a generally southeasterly direction along property now or formerly of Evelyn Reid for a total distance of 698 feet to a point located on the northern side of Highway No. 265 at a point approximately one mile from the town of Jefferson, South Carolina; then turning and running along the northwesterly side of Highway 265 for a total distance of 2,008 feet to the point of commencement; all of which is more clearly shown and delineated by a plat thereof prepared by Paul Clark, Registered Surveyor, dated January 1968, and recorded or to be recorded in the office of the Clerk of Court for Chesterfield County, South Carolina; this being the same property heretofore conveyed to the Lessors by the following four deeds: A deed from Hazel Brown McIntosh and A. A. McIntosh dated January 13, 1968, and recorded in Deed Book 189 at pages 147 through 150; a deed from First Union National Bank of North Carolina, as Executor of the

"EXHIBIT A"

Estate of T. Carlisle Smith, dated January 4, 1968, and recorded in Deed Book 189 at pages 141 through 144; a deed from Grace Brown Bongard dated January 10, 1968, and recorded in Deed Book 189 at pages 145 through 146; and a quit claim deed from Carolina Mining and Exploration Corporation dated January 13, 1968, and recorded in Deed Book 189 at pages 141 through 142. all four deeds being recorded in the office of the Clerk of Court for Chesterfield County, South Carolina.

"EXHIBIT B"

Schedule of Purchase Price

If option to Purchase is Exercised

If Lessee exercises his option to purchase under the terms and conditions set out in paragraph 21, OPTION TO PURCHASE, the purchase price shall be as follows:

From March 28, 1979 through March 27, 1980, inclusive - \$500,000.
From March 28, 1980 through March 27, 1981, inclusive - \$525,000.
From March 28, 1981 through March 27, 1982, inclusive - \$551,000.
From March 28, 1982 through March 27, 1983, inclusive - \$578,812.
From March 28, 1983 through March 27, 1984, inclusive - \$607,752.

A. J.
C. J.
L. J.
E. J.

Dr. F. C. 1/1/81
Lease/Purchase

OCT 25 1983

GOLD RESOURCES, INC.

(grantee)

515 MADISON AVENUE
NEW YORK, NEW YORK 10022

(212) 759-1930

513 MINING EXCHANGE BUILDING
8 SOUTH NEVADA AVENUE
COLORADO SPRINGS, COLORADO 80903

(303) 633-2081

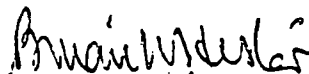
October 24, 1983

Mr. Charles E. Clonch
Nicor Mineral Ventures
Suite 4200
4949 S. Syracuse St.
Denver, CO 80237

Dear Mr. Clonch:

I enclose the Estoppel Certificate required by our joint venture agreement.

Sincerely,



Brian W. Hester
President

BWH/sm

Enclosure

OCT 28

ESTOPPEL CERTIFICATE

STATE OF SOUTH CAROLINA)
) ss.
COUNTY OF CHESTERFIELD)

The undersigned, C. M. Tucker Jr., and Alice G. Tucker of Pageland South Carolina and Dorothy H. Clark of Jefferson, South Carolina collectively hereinafter referred to as "Lessor" does hereby affirm and declare and certify to Nicor Minerals Ventures only:

1. The Lessor and Gold Resources, Inc. entered into that certain Mining Lease and Option to purchase dated March 28, 1973, which Lease has been amended by Amendment to Mining Lease date April 17, 1975; Second Amendment to Mining Lease dated March 28, 1979; (which mining Lease and Option to Purchase as amended is hereinafter called the "Mining Lease and Option to Purchase").

2. The Mining Lease and Option to Purchase is in full force and effect and is unmodified or amended except as modified and amended by the Amendments described in Paragraph 1 above.

3. The undersigned knows of no defaults under the terms of the Mining Lease and Option to Purchase by the lessee or any of the assignees of lessee and the undersigned, or any representatives of the undersigned have not served any notice of default under the terms of the Mining Lease on the lessee thereunder or any representative of the lessee.

4. All advance royalty payments and other amounts due under the Mining Lease and Option to Purchase as of the date hereof have been paid and the advance royalty is paid through December 31, 1983.

5. All exploration and development work commitments required pursuant to the Mining Lease and Option to Purchase have been performed as of the date hereof.

6. The above statements are true and correct to the best of the knowledge and belief of the undersigned.

EXECUTED this 18 day of October, 1983.

By: C. M. Tucker, Jr.
C. M. Tucker, Jr.

By: Alice G. Tucker
Alice G. Tucker

By: Dorothy H. Clark
Dorothy H. Clark

Subscribed and sworn to before me this 18 day of October, 1983.

WITNESS my hand and official seal.

My commission expires My Commission Expires April 3, 1988

Address of Notary: Rt 2 Box 273
Payson, A.C. 29728

James H. Funderburk
Notary Public

STATE OF SOUTH CAROLINA)
COUNTY OF CHESTERFIELD)

PROBATE

PERSONALLY Appeared before me Pamela R. Robertson
who being first duly sworn, says that she saw the within named C. M.
TUCKER, JR., ALICE G. TUCKER, DOROTHY H. CLARK, sign, seal, and as their
act and deed deliver the within written Agreement and that she with Eunice Smith
witnessed the execution thereof.

SWORN TO BEFORE ME THIS 23rd
day of February, 19 84.

Pamela R. Robertson
Eunice C. Smith

Brian H. Funderburk

NOTARY PUBLIC FOR SOUTH CAROLINA
My Commission Expires:
My Commission Expires April 3, 1988

STATE OF COLORADO)
COUNTY OF EL PASO) SS

On the 14th day of February, 1984, before me a Notary
Public, Personally appeared Brian W. Hester, personally known to me to
be an officer of Gold Resources, Incorporated, a private corporation
described in and which executed the foregoing instrument, and be acknowledged
that he executed the same as an act and deed of Gold Resources, Incorporated.

Brian W. Hester
Notary Public in and for said
County and State
508 Mining Exchange Buildi
Colorado Springs, CO 8090

My Commission Expires:
5/16/84



One of the NICOR
basic energy companies

NICOR MINERAL VENTURES

Suite 4200 4949 South Syracuse Street Denver, Colorado 80237 303 694 4938

October 28, 1983

Mr. Brian W. Hester
Gold Resources, Inc.
513 Mining Exchange Building
8 South Nevada Avenue
Colorado Springs, CO 80903

Gentlemen:

This is to advise you that NICOR Mineral Ventures Inc. elects to exercise its option to enter into a joint venture with Gold Resources, Inc. pursuant to paragraph 2 of the agreement dated September 13, 1983, between NICOR and GRI.

Sincerely,

NICOR MINERAL VENTURES INC.

By: 
Robert J. Miller, President

RJM/slm

000002

State of South Carolina)
)
County of Chesterfield)

AGREEMENT

WHEREAS, on the 28th day of March, 1979, C. M. Tucker, Jr. and wife, Alice G. Tucker of Pageland, South Carolina, and Dorothy H. Clark, a widow, never having remarried, of Jefferson, South Carolina, hereinafter called FIRST PARTY and Gold Resources, Inc. a private Corporation organized under the laws of the State of Delaware, having its principal place of business at 515 Madison Ave., New York, New York 10022, hereinafter called SECOND PARTY, entered into a certain Mining Lease With Option to Purchase, under the terms of which the FIRST PARTY leased and optioned the below described premises for a term of five years, and

WHEREAS, on March 28, 1979, the parties hereto executed a memorandum of said lease which was recorded on May 2nd, 1979, in Deed Book 257, Page 680-682 in the office of the Clerk of the Court, Chesterfield County, Chesterfield, South Carolina, and

WHEREAS, the parties hereto desire to amend the term of said Mining Lease With Option To Purchase, to provide for an additional term of one (1) year commencing on March 28th, 1984, and amended certain other provisions, and the parties hereto desire to record a memorandum of said amendment,

NOW, THEREFORE, for and in consideration of the sum of Ten Dollars (\$10.00) and other good and valuable consideration, the receipt of which is hereby acknowledged, both parties hereby amend the lease-option agreement dated March 28th, 1979, by virtue of an Amendment to Mining Lease with

Option To Purchase, dated the 23rd day of February, 1984, executed copies of which are in the files of both parties, on the following described premises, to wit:

All that certain piece, parcel or track of land situate, lying, and being in the County of Chesterfield, State of South Carolina, near the town of Jefferson, South Carolina, known as the "Brewer Mine", containing 1,000 acres more or less, the said property being more particularly described in "Exhibit A", attached hereto and made a part hereof.

The SECOND PARTY agrees that during the term of this lease that the FIRST PARTY has the right to cut and remove any merchantable timber from said premises.

IN WITNESS WHEREOF, the parties hereto set their hands and seals this 23rd day of February, 1984.

Signed, sealed and delivered
in the presence of:

Parula B. Robertson

C. M. Tucker, Jr.
C. M. Tucker, Jr.

Kimber C. Smith
Witnessed for Lessors

Alice G. Tucker
Alice G. Tucker

Franklin D. Smith

Dorothy H. Clark
Dorothy H. Clark
First Party

James F. Smith
Witnesses for Lessee

Brian W. Hesler
Gold Resources, Inc.
By: Brian W. Hesler,
President,

Second Party

STATE OF SOUTH CAROLINA)
COUNTY OF CHESTERFIELD)

PROBATE

PERSONALLY Appeared before me Pamela R. Robertson
who being first duly sworn, says that she saw the within named C. M.
TUCKER, JR., ALICE G. TUCKER, DOROTHY H. CLARK, sign, seal, and as their
act and deed deliver the within written Agreement and that she with Eunice Smith
witnessed the execution thereof.

SWORN TO BEFORE ME THIS 23rd
day of February, 19 84.

Pamela R. Robertson

Eunice C. Smith

Doris H. Funderburk

NOTARY PUBLIC FOR SOUTH CAROLINA

My Commission Expires:
My Commission Expires April 3, 1983

STATE OF COLORADO)
COUNTY OF EL PASO) SS

On the 14th day of February, 1984, before me a Notary
Public, Personally appeared Brian W. Hester, personally known to me to
be an officer of Gold Resources, Incorporated, a private corporation
described in and which executed the foregoing instrument, and be acknowledged
that he executed the same as an act and deed of Gold Resources, Incorporated.

Archie K. Gorton

Notary Public in and for said
County and State
508 Mining Exchange Building
Colorado Springs, CO 80903

My Commission Expires:
5/16/84



One of the NICOR
basic energy companies

NICOR MINERAL VENTURES

Suite 4200 4949 South Syracuse Street Denver, Colorado 80237 303 694 4836

January 2, 1985

Mr. Brian W. Hester
Gold Resources, Inc.
513 Mining Exchange Building
8 South Nevada Avenue
Colorado Springs, CO 80903

Re: South Carolina - Brewer Project -
First Amendment To Agreement Of
September 13, 1983

Dear Mr. Hester:

When accepted by you, this letter shall be considered by GRI and NICOR to be the First Amendment to that certain letter agreement dated September 13, 1983 by and between GRI and NICOR.

GRI and NICOR agree to amend Paragraph 3.5. Maintenance and Acquisition of the Subject Property to read as follows:

As manager of the Joint Venture, NICOR will insure that the monthly advance or minimum royalty payments contemplated by Paragraph 23 of the Mining Lease are made in a timely manner. NICOR will contribute to the Joint Venture monthly an amount sufficient to make all such payments. Amounts so contributed by NICOR will constitute a portion of NICOR's Exploration Program obligations.

At any time during the term of the Joint Venture, either party may, by notice to the other, elect to have the Joint Venture exercise the purchase option in the Mining Lease. If GRI has elected to have the Joint Venture exercise the purchase option, it will contribute to the Joint Venture funds sufficient to permit the Joint Venture to pay to the Owners the exercise price. If NICOR has elected to have the Joint Venture exercise the purchase option, GRI will be given an opportunity to contribute to the Joint Venture funds sufficient to exercise the purchase option, and if it fails to do so within twenty-one (21) days after notice of NICOR's election, NICOR will contribute such funds. Funds contributed by either party to the Joint Venture for purposes of exercising such purchase option are referred to herein as the "Acquisition Contribution".

It is further agreed that all other terms and conditions in the original letter agreement shall remain in full force and effect until terminated as provided therein.

000006

Please indicate your agreement and acceptance by signing below and by returning one (1) executed original to this office at your earliest convenience.

NICOR MINERAL VENTURES INC.



Alex F. Bissett, President

AGREED AND ACCEPTED

GOLD RESOURCES, INC.



Brian W. Hester, President

Date: 4 January 1985

RSN/AFB/br



One of the NICOR
basic energy companies

NICOR MINERAL VENTURES

Suite 4200 · 4949 South Syracuse Street · Denver, Colorado 80237 · 303 694 4938

December 10, 1985

Mr. Brian W. Hester
Gold Resources, Inc.
513 Mining Exchange Building
8 South Nevada Avenue
Colorado Springs, CO 80903

Re: South Carolina - Brewer Project -
Second Amendment To Agreement Of
September 13, 1983

Dear Mr. Hester:

When accepted by you, this letter shall be considered by GRI and NICOR to be the Second Amendment to that certain letter agreement dated September 13, 1983 by and between GRI and NICOR.

GRI and NICOR agree to amend Paragraph 3. Feasibility Study; GRI Election. by changing second full paragraph thereof to read as follows:

Subject to the further provisions hereof, NICOR will cause such feasibility study to be prepared not later than January 31, 1986, provided however that if by January 31, 1986 NICOR has contributed \$25,000 to the Joint Venture and caused such amount to be distributed to GRI, NICOR shall have until December 31, 1986 to prepare such feasibility study. In like manner, NICOR may extend from year to year the date by which such feasibility study must be prepared by causing an annual cash distribution to be made to GRI prior to each succeeding December 31. The amount of such distribution shall for each year be fifty percent (50%) greater than the distribution in the prior year. Thus, for example, the distribution prior to December 31, 1986, if any, would be \$37,500 and the distribution prior to December 31, 1987 if any, would be \$56,250. All amounts so distributed to GRI will be a credit against and will reduce any distributions to GRI pursuant to Paragraph 3.10.

It is further agreed that all other terms and conditions in the original letter agreement shall remain in full force and effect until terminated as provided therein.

000-18

Mr. Brian W. Hester
December 10, 1985
Page Two

Please indicate your agreement and acceptance by signing below and by returning one (1) executed original to this office at your earliest convenience.

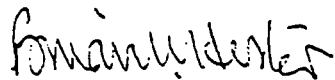
NICOR MINERAL VENTURES INC.



Alex F. Bissett, President

AGREED AND ACCEPTED

GOLD RESOURCES, INC.



Brian W. Hester, President

STATE OF SOUTH CAROLINA)
COUNTY OF CHESTERFIELD)

TITLE TO REAL ESTATE
TO A CORPORATION

000110

WHEREAS, a certain Mining Lease With Option To Purchase was made and entered into on the 28th day of March, 1979, a Memorandum of which was duly recorded on the 2nd day of May, 1979, in Deed Book 257 at Pages 680-682 in the office of the Clerk of Court for Chesterfield County, South Carolina, between C. M. Tucker, Jr., and Alice G. Tucker, his wife, of Pageland, South Carolina, and Dorothy H. Clark, a widow, of Jefferson, South Carolina, as Lessor, and Gold Resources, Inc., A Delaware Corporation, as Lessee; and,

WHEREAS, such Mining Lease With Option To Purchase was amended as of the 24th day of February, 1984, by Lessor and Gold Resources, Inc.; and,

WHEREAS, said Mining Lease With Option To Purchase was on January 15, 1985, assigned and conveyed by Gold Resources, Inc., to NICOR Mineral Ventures Inc., An Illinois Corporation, with offices at 4949 South Syracuse Street, Suite 4200, Denver, Colorado 80237; and,

WHEREAS, NICOR Mineral Ventures Inc. has exercised its Option to purchase the premises described in said Option and hereinafter described in accordance with the terms of said Mining Lease With Option To Purchase, as amended,

NOW, THEREFORE, KNOW ALL MEN BY THESE PRESENTS, THAT WE, C. M. TUCKER, JR., and DOROTHY H. CLARK, in the State aforesaid, for and in consideration of the sum of EIGHT HUNDRED THOUSAND AND NO/100 (\$800,000.00) DOLLARS to us in hand paid at and before the sealing and delivery of these Presents, by NICOR MINERAL VENTURES INC., AN ILLINOIS CORPORATION, in the State aforesaid, (the receipt whereof is hereby acknowledged), have granted, bargained, sold and released, and by these Presents to grant, bargain, sell and release unto the said NICOR MINERAL VENTURES INC., ITS SUCCESSORS AND ASSIGNS FOREVER:

All that certain piece, parcel, or tract of land situate, lying, and being in the County of Chesterfield, State of South Carolina, near the Town of Jefferson, South Carolina, known as the "Brewer Mine", containing one thousand (1,000) acres, more or less, said property being more particularly described and bounded as follows, to wit: Starting at a point on the northwest side of the intersection of Highways S. C. 265 and S. C. 110, thence along S. C. 110, north 21 degrees west, 411 feet; then north 34 degrees west 289 feet; then north 40 degrees west 1,500 feet; then north 46 degrees west 150 feet; then north 57 degrees west 200 feet; then north 68 degrees west 177 feet; then north 80 degrees west 212 feet; then south 88 degrees west 157 feet to the line of the property now or formerly owned by Robert Raley; then generally north 25 degrees west 3,341 feet along said property line to an iron at the corner of property now or formerly of Hilton and property now or formerly of McLaughlin; then turning and running in a generally northeasterly direction along property now or formerly of McLaughlin for a total distance of 1,300 feet to a point at the corner of an old cemetery; then turning and running in a generally northwesterly direction along property now or formerly of McLaughlin and Joe Thomas for a total of 2,777 feet to a point 976 feet from Lynches River; then turning and running in a generally northeasterly direction along property now or formerly of C. M. Tucker, Jr., for a total distance of 1,635 feet to some rocks; then turning and running in a generally northerly direction along property now or formerly of C. M. Tucker, Jr., for a total distance of 1,878 feet to some rocks; then turning and running in a generally northeasterly direction for a total distance of 1,981 feet to a pine; then turning and running in a generally southeasterly direction along property now or formerly of Mrs. Ruth Gregory for a total distance of 3,049 feet to a rock on Little Fork Creek; then turning and



Revenue Stamps Collected
\$ 24.80
Chesterfield County, S. C.

5th Mo. pd.
1600 " State
880 " City
Att. 71.7 Bud, atty.

-CONTINUED-

000110
S.H.C.
C. Tucker

running in a generally southeasterly direction along a line of Little Fork Creek for a total distance of 574 feet to a point on the said creek; then turning and running in a generally southeasterly direction for a total distance of 800 feet to a point on said creek; then turning and running along the line of Little Fork Creek for a total distance of 4,532 feet to a point; then turning and running in a generally southeasterly direction for a total distance of 625 feet to a birch tree; then turning and running in a generally southwesterly direction along property now or formerly of the Attie Gay Estate for a total distance of 2,083 feet to a white oak where said property adjoins that of Evelyn Reid; then turning and running in a generally southeasterly direction along property now or formerly of Evelyn Reid for a total distance of 698 feet to a point located on the northern side of Highway No. 265 at a point approximately one mile from the Town of Jefferson, South Carolina; then turning and running along the northwesterly side of Highway 265 for a total distance of 2,008 feet to the point of commencement. The above-described property is now bounded generally as follows: On the (00111 North by lands of Alice G. Tucker and by lands of C. M. Tucker, Jr.; on the Northeast by lands of William Thomas Gregory; on the East by lands of Joe F. Miller, by lands of Jackson V. Gregory, and by lands of others; on the South by South Carolina Road Number S-13-265; and on the West by lands of Canal Industries, Inc., by lands of Harriet G. Herriot, by lands of Billy Franklin Hilton, by lands of Larry H. Bird, et al, by lands of George M. Simpson and B. T. Simpson, by lands of Boise Cascade Corporation, and by lands of Tucker Associates. Said tract of land is more particularly described on a Plat of "Property Known As The Brewer Mine Near The Town Of Jefferson, South Carolina", made by Paul Clark, Registered Surveyor, dated January, 1968, and recorded in the office of the Clerk of Court for Chesterfield County, S. C., in Plat Book 31 at Page 196, and is all the land shown on said Plat lying north and east of South Carolina Road Number S-13-110, a 100-acre tract of land lying south and west of South Carolina Road Number S-13-110 having previously been conveyed by Paul Clark to C. M. Tucker, Jr., by Deed dated August 30, 1974, and recorded in said Clerk's office in Deed Book 231 at Page 596 and by C. M. Tucker, Jr., to Tucker Associates by Deed dated December 31, 1982, and recorded in said Clerk's office in Deed Book 278 at Page 982.

The above-described real estate was conveyed to Paul Clark and C. M. Tucker, Jr., by four (4) Deeds as follows: (1) Deed from First Union National Bank of North Carolina, as Executor of the Estate of T. Carlisle Smith, Deceased, dated January 4, 1968, and recorded in Deed Book 189 at Pages 143-144; (2) Deed from Grace Brown Bongard dated January 10, 1968, and recorded in Deed Book 189 at Pages 145-146; (3) Deed from Hazel Brown McIntosh and A. A. McIntosh dated January 13, 1968, and recorded in Deed Book 189 at Pages 147-148; and (4) Quitclaim Deed from Carolina Mining and Exploration Corporation dated January 13, 1968, and recorded in Deed Book 189 at Pages 141-142, all four (4) Deeds having been recorded in the office of the Clerk of Court for Chesterfield County, South Carolina, on January 15, 1968. On September 20, 1975, Paul Clark died testate devising his interest in the above-described real estate to his widow, Dorothy H. Clark, as evidenced by his Last Will and Testament on file in the office of the Probate Judge for Chesterfield County in Probate File Number 8499.

RESERVING AND EXCEPTING, HOWEVER, unto the Grantors the right to cut and remove all marketable timber from the above-described premises until February 4, 1987, at which time all timber rights of the Grantors shall expire.

THE GRANTORS SPECIFICALLY RESERVE all rights to a production royalty as set out in Paragraph Number 3 - RENTS AND ROYALTIES - of the Mining Lease With Option To Purchase, as amended, as referred to herein.

D.H.C.
Guerz

TOGETHER With all and singular the Rights, Members, Hereditaments and Appurtenances to the said Premises belonging, or in anywise incident or appertaining.

TO HAVE AND TO HOLD, All and singular, the said premises before mentioned unto the said NICOR MINERAL VENTURES INC., its successors and assigns forever.

AND We do hereby bind ourselves, our Heirs, Executors and Administrators, to warrant and forever defend all and singular the said premises unto the said NICOR MINERAL VENTURES INC., its successors and assigns, against us and our Heirs and against every person whomsoever lawfully claiming, or to claim, the same or any part thereof.

WITNESS Our Hands and Seals, this 8th day of APRIL in the year of our Lord One Thousand Nine Hundred and Eighty-Five and in the Two Hundred and Ninth Year of the Sovereignty and Independence of the United States of America.

Signed, Sealed, and

C. M. Tucker, Jr. (L.S.)
C. M. TUCKER, JR.

Delivered in the

Presence of:

Dorothy H. Clark (L.S.)
DOROTHY H. CLARK

H. F. Bell

Jeri M. Rayfield

000112

STATE OF SOUTH CAROLINA)
COUNTY OF CHESTERFIELD)

PERSONALLY appeared before me H. F. BELL

and made oath that he saw the within-named C. M. TUCKER, JR., and DOROTHY

H. CLARK sign, seal, and as their act and deed deliver the within-written

Title To Real Estate To A Corporation; and that he with JERI M.

RAYFIELD witnessed the execution thereof.

SWORN to before me this

17th day of April,

1985.

H. F. Bell

Jeri M. Rayfield (L.S.)
NOTARY PUBLIC FOR SOUTH CAROLINA

My Commission Expires: 8/10/93.

-CONTINUED-

000112

STATE OF SOUTH CAROLINA)
)
COUNTY OF CHESTERFIELD)

RENUNCIATION OF DOWER

I, H. F. BELL, Notary Public for South Carolina, do hereby certify unto all whom it may concern, that MRS. ALICE G. TUCKER, the wife of the within-named C. M. TUCKER, JR., did this day appear before me, and upon being privately and separately examined by me, did declare that she does freely, voluntarily and withing any compulsion, dread, or fear of any person or persosn whomsoever, renounce, release and forever relinquish unto the within-named NICOR MINERAL VENTURES INC., its successors and assigns, all her interest and estate, and also all her right and claim of Dower, of, in, or to all and singular the premises within mentioned and released.

GIVEN Under my Hand and

Alice G. Tucker (L.S.)
ALICE G. TUCKER

Seal, this 17th day of

April Anno Domini 1985.

H. F. Bell (L.S.)
NOTARY PUBLIC FOR SOUTH CAROLINA

000113

My Commission Expires: 10/17/89.

Thomas W. Ballard
COUNTY ASSESSOR
PARCEL # 26-13
DATE 4-19-85

FILED
CLERK OF COURT
'85 APR 17 PM 4 45
CHESTERFIELD COUNTY, S.C.
BOOK 293 PAGE 110-113

Recorded this 17th day of
April, 1985 in Book A.

Page 262.

Margaret O. White, Auditor
Chesterfield County

OCT-27-99 WED 1:26 PM BREWER GOLD CO

FAX NO. 803 658 3038

P. 2

ASSIGNMENT, CONVEYANCE AND BILL OF SALE

THIS ASSIGNMENT, CONVEYANCE AND BILL OF SALE (this "Assignment") is made this 21st day of August, 1987, by WESTMONT MINING INC., an Illinois corporation ("Seller") to BREWER GOLD COMPANY, a Delaware corporation, having offices at 4949 South Syracuse Street, Suite 4200, Denver, Colorado 80237 (the "Buyer"),

WITNESSETH:

Seller, for and in consideration of the sum of Ten dollars and other good and valuable consideration, the receipt and sufficiency of which is hereby acknowledged, does, as of 7:00 a.m. local time on July 1, 1987 (the "Effective Date"), grant, bargain, sell, convey, assign and transfer unto Buyer the following rights, titles and interests (all of which are herein called the "Subject Interests"):

1. All right, title and interest of Seller in and to the estates and leasehold interests described in Exhibit "A" hereto, insofar and only insofar as they affect the lands described in Exhibit "A", together with a like interest in Seller's rights and easements of access attributable to such interests (herein called the "Subject Properties");

2. All right, title and interest of Seller in and to the personal property and fixtures described in Exhibit "B" hereto, and all other personal property and fixtures including mining fixtures, tailing piles, severed ore and production equipment used or held for use in connection with the Subject Properties; and

3. All right, title and interest of Seller in and under all contracts, leases, easements, rights of way, agreements, permits and other instruments listed in Exhibit "C" hereto to the extent the same relate to the interests described in Section 1 or 2 above.

TO HAVE AND TO HOLD the Subject Interests and the rights, titles and interests hereby granted, bargained, sold, conveyed, assigned and transferred unto Buyer and Buyer's successors and assigns forever.

Seller hereby grants and transfers to Buyer, its successors and assigns, to the extent so transferable, the benefits of and the right to enforce the covenants and warranties, if any, which Seller is entitled to enforce with respect to the Seller's predecessors in title to the Subject Interests.

Buyer hereby assumes and agrees to pay, perform and discharge its proportionate share of all obligations arising after the Effective Date attributable to the Subject Interests.

Buyer agrees to indemnify and hold Seller harmless against any and all claims, losses, damages, liabilities and costs associated with the Subject Interests or operations thereon or for the benefit thereof, expressly including claims and liabilities associated with environmental or reclamation matters (all such claims, losses, damages, liabilities and costs herein called the "Indemnified Matters") to the extent that the Indemnified Matters relate to or arise during a time after the Effective Date of this Assignment.

The Subject Interests are assigned to Buyer without recourse, representation or covenants or warranties of title or of any other kind, whether express, implied or statutory. WITHOUT LIMITATION OF THE GENERALITY OF THE FOREGOING, SELLER EXPRESSLY DISCLAIMS AND NEGATES AS TO PERSONAL PROPERTY AND

FIXTURES (a) ANY IMPLIED OR EXPRESS WARRANTY OF MERCHANTABILITY, (b) ANY IMPLIED OR EXPRESS WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE, AND (c) ANY IMPLIED OR EXPRESS WARRANTY OF CONFORMITY TO MODELS OR SAMPLES OF MATERIALS.

The recitations in Exhibit "A" and/or Exhibit "C" that certain of the Subject Properties are subject to specifically described agreements or other instruments, shall not operate to subject any such interest to any such agreement or other instrument except to the extent that such agreement or other instrument is valid and presently subsisting with respect to such interest; nor shall the reference to any such agreement or other instrument be deemed to constitute a recognition by the parties that any such agreement or other instrument is valid except to the extent that such agreement or other instrument is presently in force and effect.

The Subject Interests are conveyed subject to valid and presently subsisting encumbrances, burdens, easements and rights of way, either of record or on the ground.

Executed this the 21st day of August, 1987, but effective as of the Effective Date.

SELLER:

ATTEST:

WESTMONT MINING INC., an Illinois corporation

Gregory G. Marlier
Name: GREGORY G. MARLIER
Title: SECRETARY

By:

[Signature]
its President

[S E A L]

Witness

Witness

BUYER:

ATTEST:

BREWER GOLD COMPANY, a Delaware corporation

Gregory G. Marlier
Name: GREGORY G. MARLIER
Title: SECRETARY

By:

[Signature]
its President

[S E A L]

Witness

Witness

STATE OF COLORADO)
) SS.
CITY AND COUNTY OF DENVER)

Personally appeared before me, Sharon A. Ellebracht, who, being duly sworn, says that she saw the corporate seal of Westmont Mining Inc., an Illinois corporation, affixed to the foregoing instrument and that she also saw A.F. Biosetti, as President of said corporation, sign and attest the same, and that she with Sandra Belts, witnessed the execution and delivery thereof as the act and deed of said corporation.

By: Sharon A. Ellebracht

WITNESS MY HAND AND OFFICIAL SEAL. Sworn to before me this 21st day of August, 1987.

William Stalls
NOTARY PUBLIC

Address: 4949 So. Syracuse
Denver, Co. 80237

My commission expires:

3/20/91

STATE OF COLORADO)
) SS. PROBATE
CITY AND COUNTY OF DENVER)

Personally appeared the undersigned witness and made oath that she saw the within named Westmont Mining Inc. sign, seal and, as its act and deed, deliver the within written instrument and that she, with other witness subscribed above, witnessed the execution thereof.

Sworn to before me this 21st day of August, 1987.

William Stalls
Notary Public for the
State of Colorado

Sandra Belts
SANDRA B. BELTS, Witness

My commission expires:

3/20/91

STATE OF MONTANA)
) SS.
GALLATIN COUNTY)

Personally appeared before me, Joanne Clayton who, being duly sworn, says that he/she saw the corporate seal of Brewer Gold Company, a Delaware corporation, affixed to the foregoing instrument and that he/she also saw M.B. Richings as President of said corporation, sign and attest the same, and the he/she with Fred Panion, witnessed the execution and delivery thereof as the act and deed of said corporation.

By: Joanne Clayton

WITNESS MY HAND AND OFFICIAL SEAL. Sworn to before me this 24 day of August, 1987.

Carole Canberry
NOTARY PUBLIC

Address: Box 628
Libby, MT 59747

My commission expires:

4-28-89

STATE OF MONTANA)
) SS. PROBATE
GALLATIN COUNTY)

Personally appeared the undersigned witness and made oath that he saw the within named Brewer Gold Company sign, seal and as its act and deed, deliver the within written instrument and that he, with other witness subscribed above, witnessed the execution thereof.

Sworn to before me this 24 day of August, 1987.

Carole Canberry
Notary Public for the
State of Montana

Fred Panion
Fred Panion Witness

My commission expires:

4-28-89

OCT-27-99 WED 1:30 PM BREWER GOLD CO

FAX NO. 803 658 3038

P. 6

EXHIBIT "A"
to
Assignment, Conveyance and Bill of Sale
from
Westmont Mining Inc.
to
Brewer Gold Company
dated effective as of
July 1, 1987

SUBJECT PROPERTIES

The Subject Properties are herein divided into four (4) groups: the Brewer Prospect, the Springs Prospect, the Small Prospect and the Stevens Prospect.

BREWER PROSPECT

All that certain piece, parcel, or tract of land situate, lying, and being in the County of Chesterfield, State of South Carolina, near the Town of Jefferson, South Carolina, known as the "Brewer Mine", containing 1,000 acres, more or less, said property being more particularly described and bounded as follows, to wit: Starting at a point on the northwest side of the intersection of Highway S.C. 265 and S.C. 110, thence along S.C. 110, north 21 degrees west, 411 feet; then north 34 degrees west 289 feet; then north 40 degrees west 1,500 feet; then north 46 degrees west 150 feet; then north 57 degrees west 200 feet; then north 68 degrees west 177 feet; then north 80 degrees west 212 feet; then south 88 degrees west 157 feet to the line of the property now or formerly owned by Robert Raley; then generally north 25 degrees west 3,341 feet along said property line to an iron at the corner of property now or formerly of Hilton and property now or formerly of McLaughlin; then turning and running in a generally northeasterly direction along property now or formerly of McLaughlin for a total distance of 1,300 feet to a point at the corner of an old cemetery; then turning and running in a generally northwesterly direction along property now or formerly of McLaughlin and Joe Thomas for a total of 2,777 feet to a point 976 feet from Lynches River; then turning and running in a generally northeasterly direction along property now or formerly of C.M. Tucker, Jr., for a total distance of 1,635 feet to some rocks; then turning and running in a generally northerly direction along property now or formerly of C.M. Tucker, Jr., for a total distance of 1,878 feet to some rocks; then turning and running in a generally northeasterly direction for a total distance of 1,981 feet to a pine; then turning and running in a generally southeasterly direction along property now or formerly of Mrs. Ruth Gregory for a total distance of 3,049 feet to a rock on Little Fork Creek; then turning and running in a generally southeasterly direction along a line of Little Fork Creek for a total distance of 574 feet to a point on the said creek; then turning and running in a generally southeasterly direction for a total distance of 800 feet to a point on said creek; then turning and running along the line of Little Fork Creek for a total distance of 4,532 feet to a point; then turning and running in a generally southeasterly direction for a total distance of 625 feet to a birch tree; then turning and running in a generally southwesterly direction along property now or formerly of the Attie Gay Estate for a total distance of 2,083 feet to a white oak where said property adjoins that of Evelyn Reid; then turning and running in a generally southeasterly direction along property now or formerly of Evelyn Reid for a total distance of 698 feet to a point located on the northern side of Highway No. 265 at a point approximately one mile from the Town of Jefferson, South Carolina; then turning and running along the northwesterly side of Highway 265 for a total distance of 2,008 feet to the point of

commencement; the above-described property is now bounded generally as follows: On the North by lands of Alice G. Tucker and by lands of C.M. Tucker, Jr.; on the Northeast by lands of William Thomas Gregory; on the East by lands of Joe F. Miller, by lands of Jackson V. Gregory, and by lands of others; on the South by South Carolina Road Number S-13-265; and on the West by lands of Canal Industries, Inc., by lands of Harriet G. Herriot, by lands of Billy Franklin Hilton, by lands of Larry H. Bird, et al, by lands of George M. Simpson and B.T. Simpson, by lands of Boise Cascade Corporation, and by lands of Tucker Associates; all of which is more clearly shown and delineated by a Plat thereof prepared by Paul Clark, Registered Surveyor, dated January, 1968, and recorded in the office of the Clerk of Court for Chesterfield County in Plat Book 31 at Page 196; and is all the land shown on said Plat lying north and east of South Carolina Road Number S-13-110, a 100-acre tract of land lying south and west of South Carolina Road Number S-13-110 having previously been conveyed by Paul Clark to C.M. Tucker, Jr., by Deed dated August 30, 1974, and recorded in said Clerk's office in Deed Book 231 at Page 596 and by C.M. Tucker, Jr., to Tucker Associates by Deed dated December 31, 1982, and recorded in said Clerk's office in Deed Book 278 at Page 982.

The above-described real estate was conveyed to Paul Clark and C. M. Tucker, Jr., by four (4) Deeds as follows: (1) Deed from First Union National Bank of North Carolina, as Executor of the Estate of T. Carlisle Smith, Deceased, dated January 4, 1968, and recorded in Deed Book 189 at Pages 143-144; (2) Deed from Grace Brown Bongard dated January 10, 1968, and recorded in Deed Book 189 at Pages 145-146; (3) Deed from Hazel Brown McIntosh and A. A. McIntosh dated January 13, 1968, and recorded in Deed Book 189 at Pages 147-148; and (4) Quitclaim Deed from Carolina Mining and Exploration Corporation dated January 13, 1968, and recorded in Deed Book 189 at Pages 141-142, all four (4) Deeds having been recorded in the office of the Clerk of Court for Chesterfield County, South Carolina, on January 15, 1968. On September 20, 1975, Paul Clark died testate devising his interest in the above-described real estate to his widow, Dorothy J. Clark, as evidenced by his Last Will and Testament on file in the office of the Probate Judge for Chesterfield County in Probate File Number 8499.

The above-described real estate was conveyed by C. M. Tucker, Jr. and Dorothy H. Clark to NICOR Mineral Ventures Inc. by instrument entitled "Title to Real Estate to a Corporation" dated April 8, 1985, and recorded in the records of Chesterfield County, South Carolina on April 17, 1985, at Deed Book 293, Page 110.

SPRING PROSPECT

That tract of land in Lancaster County, South Carolina described in the Mining Lease/Option Agreement dated March 15, 1986 between Springs Industries, Inc. and NICOR Mineral Ventures Inc. covering 8.21 acres, more specifically described as that certain piece, parcel or tract of land containing 14.0 acres, more or less, more particularly described in a plat of a survey entitled "Portion of Haile Gold Mine Tract, property of Kershaw Oil Mill" dated November 3, 1949 and recorded in Plat Book 4 at Page 54 of the Clerk of Court's Office in Lancaster County, South Carolina. Less and except a tract of land containing 5.79 acres, more or less, conveyed to the town of Kershaw by a certain deed by Water Systems and Agreement for Service by Springs Mills, Inc., dated March 12, 1975 and recorded in Deed Book B-6 at Page 5162 in said Clerk's Office. A Memorandum of Lease/Option Agreement dated March 15, 1986, was recorded May 15, 1986 in Book I-6 at Page 156 of the Lancaster County Records.

OCT-27-99 WED 1:33 PM BREWER GOLD CO

FAX NO. 803 658 3038

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EXHIBIT "C"
to
Assignment, Conveyance and Bill of Sale
from
Westmont Mining Inc.
to
Brewer Gold Company
dated effective as of
July 1, 1987

AGREEMENTS, PERMITS, ETC.

1. The properties constituting the Brewer Prospect are subject to:

- (A) Agreement dated September 13, 1983 between NICOR Mineral Ventures Inc. and Gold Resources, Inc., as amended by First Amendment dated January 2, 1985, and Second Amendment dated December 10, 1985
- (B) Mortgage dated April 8, 1985 from NICOR Mineral Ventures Inc. to C.M. Tucker, Jr. and Dorothy H. Clark, recorded on April 17, 1985 in Mortgage Book 257, Page 887 in the Office of the County Clerk for Chesterfield County, South Carolina
- (C) Production royalty reserved by grantors in warranty deed from C.M. Tucker and Dorothy H. Clark dated April 8, 1985, recorded on April 17, 1985 in Deed Book 293, at page 110, in the Office of the Clerk of Court for Chesterfield County, South Carolina
- (D) Easement granted to Carolina Power & Light Company in Agreement dated June 28, 1963, recorded in Deed Book 252, at Page 385 in the Office of the Clerk of Court for Chesterfield County, South Carolina
- (E) Entry agreements filed in the Office of the Clerk of Court for Chesterfield County, South Carolina in Deed Book 279, at page 106
- (F) Agreement, Assignment and Conveyance of Net Profits Royalty Interest dated October 31, 1986, from NICOR Mineral Ventures Inc. to NICOR Minerals Inc., recorded on December 29, 1986, in the records of Chesterfield County, South Carolina at Book 300, Page 944
- (G) South Carolina Land Resources Conservation Commission - Permit for Mining Operation No. 671.
- (H) Certificate of Deposit - #CD 8503 to State of South Carolina for Permit for Mining Operation No. 671 in the amount of \$170,000 (in lieu of reclamation bond).
- (I) South Carolina Land Resources Conservation Commission - Dam Safety Permit No. 13-447-P394.
- (J) South Carolina Department of Health and Environmental Control - NPDES Water Pollution Control Permit No. SC0040657, and Supplemental Construction Permit Nos. 13,135 and 13,172.
- (K) South Carolina Department of Health and Environmental Control - Air Quality Control Permit Nos. 0660-0026-CA, CB, CC and CD.
- (L) South Carolina Department of Health and Environmental Control - Temporary Septic Permit.
- (M) Chesterfield County, South Carolina - Building Permit Nos. 494, 495, 496 and 497.

2. The properties constituting the ~~_____~~ Prospect are subject to:

- (A) Mining Lease/Option Agreement dated March 15, 1986, between Springs Industries, Inc., and ~~NICOR Mineral Ventures Inc.~~, a memorandum of which is recorded on May 15, 1986, in the records of Lancaster County, South Carolina at Deed Book I-6, Page 156.

001-80

OCT-27-99 WED 1:35 PM BREWER GOLD CO

FAX NO. 803 658 3038

P. 9

WESTMONT

WESTMONT

ASSET DESCRIPTIONSERIAL NUMBER

1. Portable Light Plant

85099147

2. Air Conditioner

H711-56103

3. Compressor

4141X385

4. Miller Welder

JH178895

5. Miller Welder

JH214361

6. Conditioner for 769C CAT Truck

7. Conditioner for 769C CAT Truck

8. Conditioner for 769C CAT Truck

9. Conditioner for 769C CAT Truck

10. Air Compressor

QCYF325-5-3PH

11. Ford F800 Crane Truck

RBIDVDJ7004

12. Ford F150 Ford Pickup

1FTDF15Y4HNA40858

13. Ford F150 Ford 4 Wheel Drive Pickup

1FTEF14XBNA71750

14. Mack Fuel/Lube Truck

U686ST6295

15. Jersey Trailer 42' Van

127698

16. Ford 350 Truck

1FDKF37L6HNA79810

17. Ford 350 Truck

1FDKF37LXHNA36445

18. Ford F150 Four Wheel Drive

1FTEF14Y4HNA33284

19. Ford Taurus Auto

1FABP50D4HA218577

20. Vertical Sump Pumps

SP87 24256

21. Vertical Sump Pumps

SP87 24257

22. Minolta Copier w/ Sorter, Feeder, Cabinet

16758

23. Minolta Copier w/ Stand

1612469

24. Typewriter

6058788

25. Typewriter

6076273

26. Transcriber w/ Foot Control-Dictaphone

3710

27. Cabinets and Bookcase

28. Word Processing System

1046615

29. Mine Engineering Computer System

4719AJ2B0004

30. Accounting Computer System

4650AJ3B1088

31. Nikon Transit

320438

32. Blueprint Machine MOD 6050

119638

OCT-27-99 WED 1:36 PM BREWER GOLD CO

FAX NO. 803 658 3038

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EQUIPMENT DESCRIPTIONSERIAL NUMBER

Radial Stacker Conveyor 24" x 120'	9900
Evaporation Station w/Rain Gauge	92576
4" x 150# Brooks Wafer Meter	7415B3W1E1AA
4" x 150# Brooks Wafer Meter	7404B3W1E1AA
Duriron Process Pumps w/10 HP Motor	318596
Duriron Process Pumps w/10 HP Motor	318597
MOD 15-Q-3 Lighting Mixer w/3 HP Motor	873614002
Allis-Chalmers Balling Drum 1" x 31' 10 3/4" w/40 HP Motor	2289
Duriron Process Pumps 1 1/2" x 1 8/62" w/1 1/2 HP Motor	318649
Duriron Process Pumps 1 1/2" x 1 8/62" w/1 1/2 HP Motor	318640
Motor Control Center	P664721/1
Cement Silo	
Fusion Welding Machine	GA0290
Le Fabre Safe 12 1/2 x 12 1/2 x 12	
MOD C6B20 Gorman-Rupp Pump w/60 HP Motor	870438
MOD C6B20 Gorman-Rupp Pump w/60 HP Motor	870439
SELEN Generator	16KVA014956
S-12 Series Marathon Pump w/Float Switch & Level Control	
S-12 Series Marathon Pump w/Float Switch & Level Control	
20" x 19" x 39" Sample Splitter	
Pansey Totalizer Counter Weighing Station MOD 10-20-1-21	3107
MOD 600 Allis-Chalmers 2" x 1 1/2 Process Water Pump with 525 gal. Pressure Tank	871-60883-01-1
24" x 100' Portable Stacking Conveyor	6-866
MOD 1350 Heath & Sherwood Sampler	8726
4" x 5" Morse Jaw Crusher	JC4-612
Allis Portable Light Plant	850592I1
Allis Portable Light Plant	85059209
Allis Portable Light Plant	85099349

OCT-27-99 WED 1:37 PM BREWER GOLD CO

FAX NO. 803 658 3038

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EXHIBIT "D"
to
Assignment, Conveyance and Bill of Sale
from
Westmont Mining Inc.
to
Brewer Gold Company
dated effective as of
July 1, 1987

PERSONAL PROPERTY & FIXTURES

<u>EQUIPMENT DESCRIPTION</u>	<u>SERIAL NUMBER</u>
MOB 269C CAT 35/Ton Haul Truck	1X2740
MOB 269C CAT 35/Ton Haul Truck	1X2742
MOB 269C CAT 35/Ton Haul Truck	1X2746
MOB 269C CAT 35/Ton Haul Truck	1X2370
D400H Drill-Tech Drill	731313
5000 Terex Tractor	62486
M30 MEGA Water Wagon	87135
700SG Dresser Dozer	4362
RON Ingersoll-Rand Crawler Drill	V94304
R100 Ingersoll-Rand Air-Compressor	143355
140 CAT Motorgrader	96U5724
900 210B John Deere Wheel Loader/Backhoe	722613
1900 Hyster Craft MC-15 Forklift	409N
500B Dresser Front End Loader	4363
500B Dresser Front End Loader	4362
400 11042 Hewitt-Robins Portable Jaw Crusher	C7054-01
MOB 115 Hewitt-Robins Varicone Portable Crusher	C20C10035-01
Omaha Mitt Pugmill	1018-500
Kolberg Conveyor 24" x 100' Portable	S/N 6280-2424-100-81
Kolberg Conveyor 24" x 100' Portable	S/N 6281-2424-100-82
Kolberg Conveyor 24" x 100' Portable	S/N 6282-2424-100-83
Kolberg Conveyor 24" x 100' Portable	S/N 6283-2424-100-84
Kolberg Conveyor 24" x 100' Portable	S/N 6284-2424-100-85
Kolberg Conveyor 24" x 100' Portable	S/N 6285-2424-100-86
Kolberg Conveyor 24" x 100' Portable	S/N 6287-2424-100-87
Kolberg Conveyor 24" x 100' Portable	S/N 6288-2424-100-88
Kolberg Conveyor 24" x 100' Portable	S/N 6289-2424-100-89
Kolberg Conveyor 24" x 100' Portable	S/N 6290-2424-100-90

OCT-27-99 WED 1:37 PM BREWER GOLD CO

FAX NO. 803 658 3038

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ASSET DESCRIPTION

SERIAL NUMBER

Asset is 1/2 x 46 3/8 x 35
File Cabinet

Lease Air Conditioning Unit

H71156103

Lease Meter

F2204546

Lease, Adding Machines, and
Office Equipment

Lease Building

Lease Refinery Building

Lease Shop Building

Lease Road

Asset is not purchased subsequent to June 30, 1987 and is
not Brewer Mine Operation.

AMENDMENT NO. 1
TO
AGREEMENT, ASSIGNMENT
AND CONVEYANCE OF NET
PROFITS ROYALTY INTEREST

THIS AMENDMENT NO. 1 TO AGREEMENT, ASSIGNMENT AND CONVEYANCE OF NET PROFITS ROYALTY INTEREST (the "Amendment") is executed on this 9th day of November, 1988, but effective as of October 31, 1986, by and between WESTMONT MINING INC., an Illinois corporation, BREWER GOLD COMPANY, a Delaware corporation, and WESTMONT GOLD INC., a Delaware corporation (collectively referred to herein as "Westmont") and NICOR Minerals Inc., a Delaware corporation ("NMI").

WITNESSETH

WHEREAS, NICOR Mineral Ventures Inc. ("NMV"), an Illinois corporation and NMI have heretofore entered into that certain Agreement, Assignment and Conveyance of Net Profits Royalty Interest dated as of October 31, 1986 (the "Agreement"), and recorded in the states and counties where the affected projects are located, as are more fully described in Exhibit A, attached hereto;

WHEREAS, NICOR Mineral Ventures Inc. formally changed its name to Westmont Mining Inc. and assigned its interest in the Brewer Project to Brewer Gold Company, a wholly-owned subsidiary and its interest in the remaining Projects listed on Exhibit A to Westmont Gold Inc., a wholly-owned subsidiary (with all three companies being collectively referred to in this Amendment as "Westmont"); and

WHEREAS, Westmont and NMI now jointly desire to amend the Agreement to clarify the intent of same;

NOW THEREFORE, in consideration of the mutual covenants contained herein, Westmont and NMI agree as follows:

1. Section 4(b) of the Agreement is hereby amended to read as follows:

(b) Account to be a Profit/Loss Account. The Net Profits Account shall be a profit-loss account prepared in conformity with Generally Accepted Accounting Principles ("GAAP") applied on a consistent basis and shall present fairly Westmont's share of the net profits or losses generated by mining on the Subject Properties. The Net Profits Royalty shall be calculated on the basis of

deducting, from Westmont's share of gross revenues realized (or deemed to be realized in the case of a sale to an Affiliate and as determined in accordance with Section 4(c) hereof) from the sale of Subject Minerals (subject, however, to Section 3(c) hereof), NMV's and Westmont's share of costs and expenses commencing with the acquisition of the Subject Properties covered hereby (expressly excluding all state and federal income taxes) that are attributable to (among other appropriate matters) the maintenance, evaluation, exploration, development, mining, processing, refining, smelting and marketing of Subject Minerals from the Subject Properties. Development costs shall include all costs associated with all preparation for the removal and recovery of Subject Minerals, including the construction or installation of a mill or other facility and any other improvements to be used for the mining, handling, milling, processing or other beneficiation of Subject Minerals. Specifically included within the costs and expenses chargeable to the Net Profits Account are the following: (i) costs and expenses incurred by either NMV or Westmont and their Affiliates which are directly attributable to the Subject Properties, the operation thereof, or any activity related thereto; provided, however, that the cost of any item (except those items expressly excluded below) which is customarily considered in the mining industry to be a capital item (including as examples, pre-production mining costs, plant construction, buildings and equipment costs) and which are customarily depreciated, amortized or depleted under GAAP (the "Capitalized Items"), shall be charged monthly to the Net Profits Account on the basis of the monthly amount of such depreciation, amortization and depletion charges as determined under GAAP. Expressly excluded from the category of Capitalized Items are all costs of exploration, evaluation, and pre-production working capital, which shall be fully chargeable to the Net Profits Account when incurred; (ii) an amount equal to a reasonable charge for overhead of Westmont to cover the portion thereof properly allocable to the Subject Minerals, the Subject Properties, milling and processing facilities and marketing activities (such amount, however, not to exceed (a) ten percent (10%) of Westmont's share of the costs (which costs shall not include capital expenditures on property, plant and equipment and shall not include imputed interest referred

to in clause 4(b)(iii) below) with respect to the project prior to making of the first commercial sale, or (b) three percent (3%) of the greater of such costs of the project or of Westmont's share of gross sales revenues after the first commercial sale); and (iii) during all periods commencing on November 1, 1986, when the Net Profits Account has a negative balance, an amount equal to imputed interest on such negative balance at an annual rate, adjusted at the end of each calendar quarter, equal to the prime rate, or any successor reference rate of interest announced publicly time to time by First National Bank of Chicago; provided, however, that no such imputed interest charges to the Net Profits Account shall be considered in calculating the existence or size of any negative balance thereof for purposes of calculating any charge pursuant to this Subsection 4(b)(iii).

2. Except as herein amended, Westmont and NMI ratify and confirm that the Agreement is in full force and effect.
3. This Amendment is binding upon the parties hereto and their respective successors and assigns.

IN WITNESS WHEREOF, the parties have executed this Amendment as of the date first above written, but effective as of October 31, 1986.

ATTEST:

Gregory L. Mark
Secretary

ATTEST:

Gregory L. Mark
Secretary

ATTEST:

Gregory L. Mark
Secretary

WESTMONT MINING INC.

By: Alex F. Bissett
Alex F. Bissett, President
BREWER GOLD COMPANY

By: Michael B. Richings
Michael B. Richings, President
WESTMONT GOLD INC.

By: Alex F. Bissett
Alex F. Bissett, President

ATTEST:

Alexander C. Alaya
Secretary

NICOR MINERALS INC.

By: John J. Alameda
Title: Treasurer

STATE OF Colorado)
COUNTY OF Denver) ss.

On this 9th day of January, in the year 1988, before me, Sharon A. Ellebracht, a Notary Public of said State, duly qualified, commissioned and sworn, personally appeared Alex F. Bissett and Gregory G. Marlier, known to me to be the President and Secretary, respectively, of Westmont Mining Inc. and of Westmont Gold Inc. and also personally appeared Michael B. Richings and Gregory G. Marlier, known to me to be the President and Secretary, respectively, of Brewer Gold Company, and acknowledged to me that such corporations executed the same.

California

Personally appeared before me each such persons, known to me to be the persons who executed the within instrument on behalf of the corporations; set opposite their names, and acknowledged to me that such corporations executed the same.

Colorado

The foregoing instrument was acknowledged before me this day by each such persons on behalf of said corporations.

Illinois

The foregoing instrument was acknowledged before me this day by said persons as the designated officers of the corporations or association set opposite their names (or as Trustees, as the case may be) on behalf of said corporations or association (or themselves, as Trustees).

Nevada

On the above date personally appeared before me, a notary public, such persons who acknowledged that they executed the above instrument.

South Carolina

Personally appeared before me such persons who, being duly sworn, says that he saw the corporate seal of the said corporations affixed to the foregoing instrument and the he also saw the president and the secretary of said corporations, sign and attest the same, and that he witnessed the execution and delivery thereof as the act and deed of such persons.

Witness my hand and official seal.

[SEAL]



Sharon A. Ellebracht
Notary Public

Residing at 4949 S. Syracuse St.
Denver, Co 80237

My commission expires: June 16, 1991

STATE OF Illinois)
COUNTY OF DuPage) ss.

On this 9th day of November, in the year 1988, before me,
Bruce W. Gilbert, a Notary Public of said
State, duly qualified, commissioned and sworn, personally appeared
Donald W. Lohrentz and Alexander C. Allison of
NICOR Minerals Inc., respectively, and acknowledged to me that such
corporation executed the same.

California Personally appeared before me each such
persons, known to me to be the persons who
executed the within instrument on behalf of the
corporation set opposite their names, and
acknowledged to me that such corporation
executed the same.

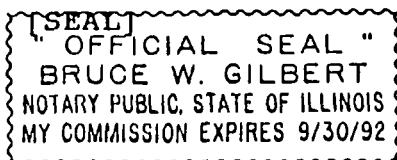
Colorado The foregoing instrument was acknowledged
before me this day by each such persons on
behalf of said corporation.

Illinois The foregoing instrument was acknowledged
before me this day by said persons as the
designated officers of the corporation or
association set opposite their names (or as
Trustees, as the case may be) on behalf of said
corporation or association (or themselves, as
Trustees).

Nevada On the above date personally appeared before
me, a notary public, such persons who
acknowledged that they executed the above
instrument.

South Carolina Personally appeared before me such persons who,
being duly sworn, says that he saw the
corporate seal of the said corporation affixed
to the foregoing instrument and the he also saw
the president and the secretary of said
corporation, sign and attest the same, and that
he witnessed the execution and delivery thereof
as the act and deed of such persons.

Witness my hand and official seal.



Bruce W. Gilbert
Notary Public

Residing at _____
Naperville, Illinois 60540

My commission expires:

EXHIBIT A

Summary of Recording Data
for
Agreement, Assignment and Conveyance of
Net Profits Royalty Interest

Dated as of October 31, 1986

<u>Project</u>	<u>County/ State</u>	<u>Recording Date</u>	<u>Reception Number</u>	<u>Book</u>	<u>Page</u>
Riverside Pass	Riverside/ California	11/12/86	286771	N/A	N/A
New Pass	Churchill/ Nevada	11/10/86	223531	N/A	N/A
Bullion- Monarch	Eureka/ Nevada	11/10/86	106207	152	047
Railroad	Elko/ Nevada	11/10/86	221956	542	88
Mount Hamilton	White Pine/ Nevada	11/10/86	240526	103	194
Brewer	Chesterfield/ So. Carolina	12/29/86	N/A	300	944
	Lancaster/ So. Carolina	12/29/86	4157	T-6	90

FEE \$10.00 FILE 253887
FILED FOR RECORD
AT THE REQUEST OF

Westmont Mining
'89 JAN 12 AIO:14

RECORDED 144 214-219
LIBA SHERIFF DEPT
WHITE PINE COUNTY RECORDER

FILED
OFFICE OF CLERK
OF COURTSTATE OF SOUTH CAROLINA)
COUNTY OF LANCASTER)

DEED AND GRANT OF EASEMENT '91

KNOW ALL MEN BY THESE PRESENTS that SPRINGS INDUSTRIES, INC., a South Carolina corporation whose address for purposes of this Instrument is P.O. Box 70, 205 North White Street, Fort Mill, South Carolina, formerly known as The Springs Cotton Mills (hereinafter referred to as "Grantor"), in consideration of the sum of \$10.00 and other good and valuable consideration to it in hand paid by BREWER GOLD COMPANY, a Delaware corporation whose address for purposes of this Instrument is 4949 South Syracuse Street, Suite 4200, Denver, Colorado 80237 (hereinafter referred to as "Grantee"), the receipt and sufficiency of which is hereby acknowledged, has granted, bargained, sold and released and by these presents does grant, bargain, sell, release and quitclaim unto the said Grantee, its successors and assigns forever, all of Grantor's right, title, and interest whatever same may be in and to the following:

1. All that certain piece, parcel or tract of land situated, lying and being in Lancaster County, South Carolina that is described in Exhibit A attached hereto and by this reference incorporated herein (hereinafter referred to as the "Deed Property"), including the entire undivided fee interest therein and in the mineral estate appurtenant thereto, RESERVING unto the Grantor, its successors and assigns forever, a Net Smelter Return production royalty (hereinafter referred to as "Royalty") on all ores and minerals produced and sold from the Deed Property subsequent to the date of this Deed and Grant of Easement (herein referred to as this "Instrument") at the rates and subject to the terms and conditions set forth in this Instrument; and
2. An easement and right-of-way (hereinafter referred to as the "Easement" or "Relocated Easement"), as more particularly described in and subject to the provisions of this Instrument, to enter upon and across and utilize portions of that certain piece, parcel or tract of land situated in Lancaster County, South Carolina that is described in Exhibit B attached hereto and by this reference incorporated herein (hereinafter referred to as the "Easement Property").

Together with all and singular the rights, members, hereditaments and appurtenances to said Deed Property belonging or in any wise incident or appertaining thereto. This Deed and Grant of Easement is subject to the following:

1. Calculation of Production Royalty. Pursuant to the reservation of Royalty described above, Grantor shall be paid a percentage of the Net Smelter Return (as hereinafter defined) received by Grantee for sale of all ores and minerals produced and sold from the Deed Property subsequent to the date of this Instrument. The percentage of Net Smelter Return shall be based on the closing price per Troy ounce of gold bullion as quoted daily by Englehard Industries in New York, New York and published by the Wall Street Journal for the date of settlement by the smelter according to the following table:

<u>Percent of Net Net Smelter</u>	<u>Englehard Price Per Troy Ounce of Gold Bullion</u>
Four percent (4%)	Up to \$500.00
Five percent (5%)	\$500.01 to \$600.00
Six percent (6%)	\$600.01 to \$900.00
Seven percent (7%)	More than \$900.00

"Net Smelter Return," as used herein, means the amount of earned revenue, as used in accordance with generally accepted accounting principles in the mining industry, payable to Grantee by any smelter or other purchaser of ores, metals, minerals, or byproducts mined or produced from the Deed Property subsequent to the date of this Instrument, less all penalties, assaying, sampling, transportation and smelting charges. In the event such ores, minerals or

metals are treated or smelted by or for Grantee, the term "Net Smelter Return" shall mean the amount of earned revenue which would have been paid to Grantee by a bona fide purchaser of said ore, minerals, or metals, less all smelting penalties, assaying, sampling, transportation and smelting charges. If the said minerals are not sold but rather consumed by Grantee, such production Royalty shall be calculated on the basis of the market price at the time such mineral was consumed.

2. Payment Method. Grantor shall be paid Royalty monthly, on or before the 30th day of the month following each calendar month that Grantee receives proceeds from the sale of minerals produced from the Deed Property. All payments shall be made to the Grantor at the address specified above in this Instrument unless Grantor designates to Grantee, by written and executed notice, a different receiving address or account to receive such payments. In the event of a present or future division of Grantor's Royalty interest, payment to such single address or account shall constitute full satisfaction of Grantee's obligation to pay Royalty, and Grantee shall be relieved from any responsibility and liability for the division or distribution of disbursements as among the various Royalty recipients.

3. Nature of Royalty. The Royalty interest shall run with the land and constitute a burden on the Deed Property. Grantee shall have no obligation, express or implied, to begin or to prosecute exploration, development, mining or any other operation upon the Deed Property, and the extent, timing, location, rate and method of such operations, if any, shall be decided within the sole discretion of Grantee. The Royalty interest created hereunder is contractual in nature and not an interest in mineral in place and does not entitle the Grantor to participate in any decisions concerning the Deed Property or the operation thereof.

4. Lesser Interest. If this Instrument conveys unto Grantee less than the entire undivided interest in the Deed Property and the mineral estate appurtenant thereto, then the Royalty provided for herein shall be paid to Grantor only in the proportion that the actual interest in the Deed Property and the mineral estate therein conveyed unto Grantee by this Instrument bears to the whole and undivided interest. With respect to that portion, if any, of the Deed Property which is not conveyed unto Grantee by this Instrument, Grantee is under no obligation to pay, and Grantor has no right to receive, any type of Royalty.

5. After Acquired Title. In the event that Grantor now owns or subsequently acquires any further right, title or interest in or to the Deed Property or the mineral estate appurtenant thereto, Grantor shall, without further charge or consideration, convey such right, title or interest unto Grantee by delivery of a properly executed, witnessed, and acknowledged deed suitable for recordation.

6. Commingling. Grantee shall have the right to commingle minerals produced from the Deed Property with ore or minerals produced from other properties for the purposes of transportation, storage, milling, processing, treatment, leaching, and/or sale or disposition. In the event that such commingling occurs, Grantee shall perform sufficient monitoring, sampling and analysis to make an accurate determination of Royalty payable to Grantor hereunder.

7. Books, Records and Information. Grantee shall keep accurate records of minerals derived and sold from the Deed Property and of calculations relative to Royalty payments and commingled ore from the Deed Property. Royalty payments and adjustments shall be accompanied by a statement of Royalty payment calculations. Upon thirty (30) days' prior written notice, Grantor shall be entitled to conduct an independent audit of the matters governed by the statement, during normal business hours and at Grantor's sole expense, provided that Grantor selects for the audit an accounting firm of recognized standing, at least one of whose members is a certified public accountant.

8. Derivation Clause. The Springs Cotton Mills, the corporate predecessor of Grantor, acquired its title to the Deed Property by deed from Kershaw Oil Mill, a South Carolina corporation, which deed was recorded in Lancaster County, South Carolina on December 16, 1949 at Book A4, Page 348.

9. 1946 Agreement. This conveyance is subject to the property rights, privileges and easements, in and to the described premises of Haile Mine, Inc., under a certain instrument executed by James P. Beckwith to Haile Mine, Inc., dated June 21, 1946, recorded in the Office of the Clerk of Court for Lancaster County, South Carolina, in Deed Book S-3 at Page 206; the rights of the said James P. Beckwith as Lessor having been subsequently assigned to Kershaw Oil Mill under a certain instrument dated June 21, 1946, recorded in Deed Book S-3 at page 310.

Grantor grants, bargains, sells releases and quitclaims unto Grantee any and all right, title and interest that Grantor may hold in, to, or arising under said instrument dated June 21, 1946.

10. Easement.

a. Location of Easement. With respect to the Easement, Grantee shall have the right to use the existing road that currently traverses the Easement Property in a north/northwesterly direction from South Carolina State Highway 564 to the Deed Property and the spur of such road that accesses the "Town of Kershaw Property" (as hereinafter defined). The approximate location of such road and spur (which are collectively referred to hereinafter as the "Easement Road") is generally depicted on the map appended hereto and incorporated herein as Exhibit C. As used herein, the "Town of Kershaw Property" means that certain tract of land comprised of approximately 5.79 acres that is situated to the east of the Deed Property and that is depicted on Exhibit C as, the "Town of Kershaw Property." Unless relocated pursuant to Section 10.b. below, the Easement shall be deemed to cover the Easement Road and such areas immediately adjacent to the Easement Road not to exceed a total maximum width of forty (40) feet as may be reasonably necessary to fulfill the purposes of the Easement as described in this Instrument.

b. Relocation of Easement. The location of the Easement described above in Section 10.a. shall apply for so long as the "Easement Property Option Agreement" is in effect. As used herein, the term "Easement Property Option Agreement" means that certain Mining Lease with Option to Purchase dated as of February 24, 1989 by and between Grantor and Westmont Mining Inc. (a corporation affiliated with Grantee and hereinafter referred to as "Westmont") with respect to the Easement Property, and any renewal, extension, amendment or replacement thereof. In the event that the Easement Property Option Agreement terminates or expires, other than pursuant to Westmont's, or its successors or assigns, exercise of its option to purchase the Easement Property, Grantor shall have the right to require relocation of the Easement in accordance with the provisions of this Section 10.b. Grantor shall only require relocation of the Easement in the event that, subsequent to the term of the Easement Property Option Agreement, use of the Easement Road by Grantee interferes with Grantor's, or Grantor's successors or assigns, use or anticipated use of the Easement Property. Grantor shall provide Grantee with no less than 180 days prior written notice that the Easement must be relocated. Grantee shall have the right to continue to use the Easement Road and required areas immediately adjacent thereto during such period of not less than 180 days. At the end of that period, Grantee shall abandon the Easement Road and the Easement herein given over the Easement Road shall terminate and a Termination of Easement will be executed and recorded by Grantor. Concurrent with Grantor's notice that the Easement Road must be relocated, Grantor shall designate to Grantee a new location for the Easement across the Easement Property which provides access to and from the Deed Property to South Carolina State Highway No. 564 and which is hereinafter referred to as the "Relocated Easement" and a new Easement will be executed and recorded by Grantor. Upon receipt of such notice of required relocation, Grantee shall have the

right, but not the obligation, to construct the Relocated Easement at the location designated by Grantor including the right to have access across the Easement Property up to fifty (50) feet on either side of the Relocated Easement during the period of such construction only. Grantee's rights shall include, without limitation, the right, at Grantee's sole expense, to construct, use, maintain and repair a road suitable for the purposes of the Easement.

c. Scope and Purpose of Easement. Grantee shall have the right to use the Easement Road for ingress to and egress from the Deed Property. Grantee shall have the right, and the obligation, to use, maintain, and repair the Easement Road. Grantee shall also have the right, but not the obligation, to widen or expand the Easement Road, but not to exceed a maximum width of forty (40) feet for so long as Grantee is conducting its mining operations on the Deed Property. If Grantee widens or expands the Easement Road as permitted herein, Grantee covenants to reclaim and restore the Easement Road to its original width as soon as practicable after completing its mining operations on the Deed Property and in any event within twelve (12) months after mining operations on the Deed Property cease, but in no event shall the width of the Easement Road be more than the standard allowable width for county roads in Lancaster County, South Carolina, as provided by the appropriate State or County laws, rules, and regulations.

Grantee shall also have the right, subject to the consent of Grantor, to construct, use, operate, maintain, repair, replace and remove electrical transmission, water, telephone or utility lines or pipelines, and their necessary appurtenances, along or immediately adjacent to the Easement Road, provided that the total width of the Easement and the associated appurtenances do not exceed the limits provided for in the preceding paragraph. In the event that Grantor requires relocation of the Easement in accordance with Section 10.b. above, Grantee's rights and obligations with respect to the Relocated Easement shall be the same as its rights and obligations described above with respect to the Easement Road. All use of or relocation of the Easement by Grantee hereunder shall be at Grantee's sole expense.

d. Term. The Easement or Relocated Easement provided for in this Instrument shall expire and terminate on December 31, 1996, unless extended in writing by Grantor. Upon written request by Grantor at any time after December 31, 1996, or any written extension thereof, Grantee shall abandon the Easement or Relocated Easement and execute and deliver to Grantor a recordable termination of Easement or Relocated Easement document.

If Grantee has widened or expanded the Easement or Relocated Easement prior to the actual date of termination, Grantee covenants to promptly reclaim and restore the Easement Road to its original width as provided for in Section 10 c. above as soon as practicable and in any event within six (6) months after the actual date of termination of the Easement.

e. Indemnification. Grantee shall indemnify and hold harmless Grantor against any and all loss, cost, claim, damage, expense, and demand, including, without limitation, court costs and reasonable attorney's fees, threatened against or incurred by Grantor and arising from and out of or in any manner connected with the use and enjoyment by Grantee of the Easement, except for any such losses, claims, damages expenses and demands, including, without limitation, court costs and reasonable attorney's fees, which may be necessary to enforce Grantee's rights to the Easement under this instrument as against Grantor.

f. Grantor's Easement Rights. Grantor reserves to itself the use and enjoyment of the Easement Road or Relocated Easement for all legal purposes not inconsistent with and which do not materially adversely interfere with, impede, or diminish the rights and privileges of Grantee created and existing under and by virtue of the Easement.

g. Inurement. The Easement, whether over the Easement Road or the Relocated Easement, shall burden and run with the Easement Property until the expiration of the term of the Easement or Relocated Easement. Grantee may not assign or transfer any or all of its rights and interests in the Easement without first obtaining the written consent of Grantor.

h. After Acquired Title. If Grantor now owns or subsequently acquires any further right, title or interest in or to the Easement Property, such right, title and interest shall, without further consideration or charge, be subject to the Easement and all the rights of Grantee under this Instrument.

WITNESS the hand and seal of Springs Industries, Inc. on this, the 10th day of September, 1991.

SIGNED, SEALED AND DELIVERED
IN THE PRESENCE OF:

SPRINGS INDUSTRIES, INC.

Elaine Bakke
Witness

By: James F. Zahn
James F. Zahn, Treasurer

Patricia M. Kimbrell
Witness

[S E A L]

ATTEST:
Robert W. Sullivan
Robert W. Sullivan, Assistant Secretary

Brewer Gold Company, as additional consideration for this Deed and Grant of Easement, hereby agrees to the provisions hereof, including, but not limited to, Grantor's reservation of Royalty.

WITNESS the hand and seal of Brewer Gold Company on this, the _____ day of _____, 1991.

SIGNED, SEALED AND DELIVERED
IN THE PRESENCE OF:

BREWER GOLD COMPANY

[Signature]
Witness
Joseph H. McCall
Witness

By: Ralph Mattson
Ralph Mattson, President

[S E A L]

ATTEST:
By: Jeannie M. Skepnek
Jeannie M. Skepnek, Secretary

Robert J. Cali
Witness
[Signature]
Witness

STATE OF South Carolina)
)
 COUNTY OF Chesterfield) SS

Personally appeared before me J. M. Stonehouse, who, being duly sworn, says that he saw Ralph Mattson, President, of said Brewer Gold Company, sign and attest the same, and that he with Joseph A. McMillan witnessed the execution and delivery thereof as the act and deed of the said Brewer Gold Company.

[Signature]

Sworn before me this 11th day of September, 1991, J. Hassie Jones, Notary Public for South Carolina. My commission expires May 20, 1995.

[SEAL]

[Signature]
 Notary Public

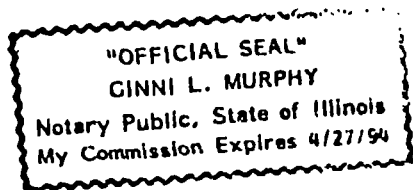
STATE OF ILLINOIS)
)
 COUNTY OF Will) SS

Personally appeared before me PHILIP S. CALI, who, being duly sworn, says that he saw the corporate seal of Brewer Gold Company affixed to the foregoing instrument and that he also saw Jeannie M. Skepnek, Secretary, of said Brewer Gold Company, sign and attest the same, and that he with JAMES K. GREENLEE witnessed the execution and delivery thereof as the act and deed of the said Brewer Gold Company.

[Signature]

Sworn before me this 12th day of September, 1991, Ginni L. Murphy, Notary Public for Illinois. My commission expires 4/27/94.

[SEAL]



[Signature]
 Notary Public

STATE OF SOUTH CAROLINA)
)
COUNTY OF YORK) SS

Personally appeared before me ELAINE BALDWIN, who, being duly sworn, says that he saw the corporate seal of Springs Industries, Inc., affixed to the foregoing instrument and that he also saw James F. Zahrn, Treasurer, and Robert W. Sullivan, Assistant Secretary of said Springs Industries, Inc., sign and attest the same, and that he with PATRICIA M. KIMBRELL witnessed the execution and delivery thereof as the act and deed of the said Springs Industries, Inc.

Elaine Baldwin

Sworn before me this 10th day of September, 1991, Rosalyn P. Sutton, Notary Public for South Carolina. My commission expires 1-16-97.

[SEAL]

Rosalyn P. Sutton
Notary Public

EXHIBIT A
to that certain
DEED AND GRANT OF EASEMENT
from
SPRINGS INDUSTRIES, INC.,
a South Carolina corporation ("Grantor")
to
BREWER GOLD COMPANY,
a Delaware corporation ("Grantee")

DEED PROPERTY

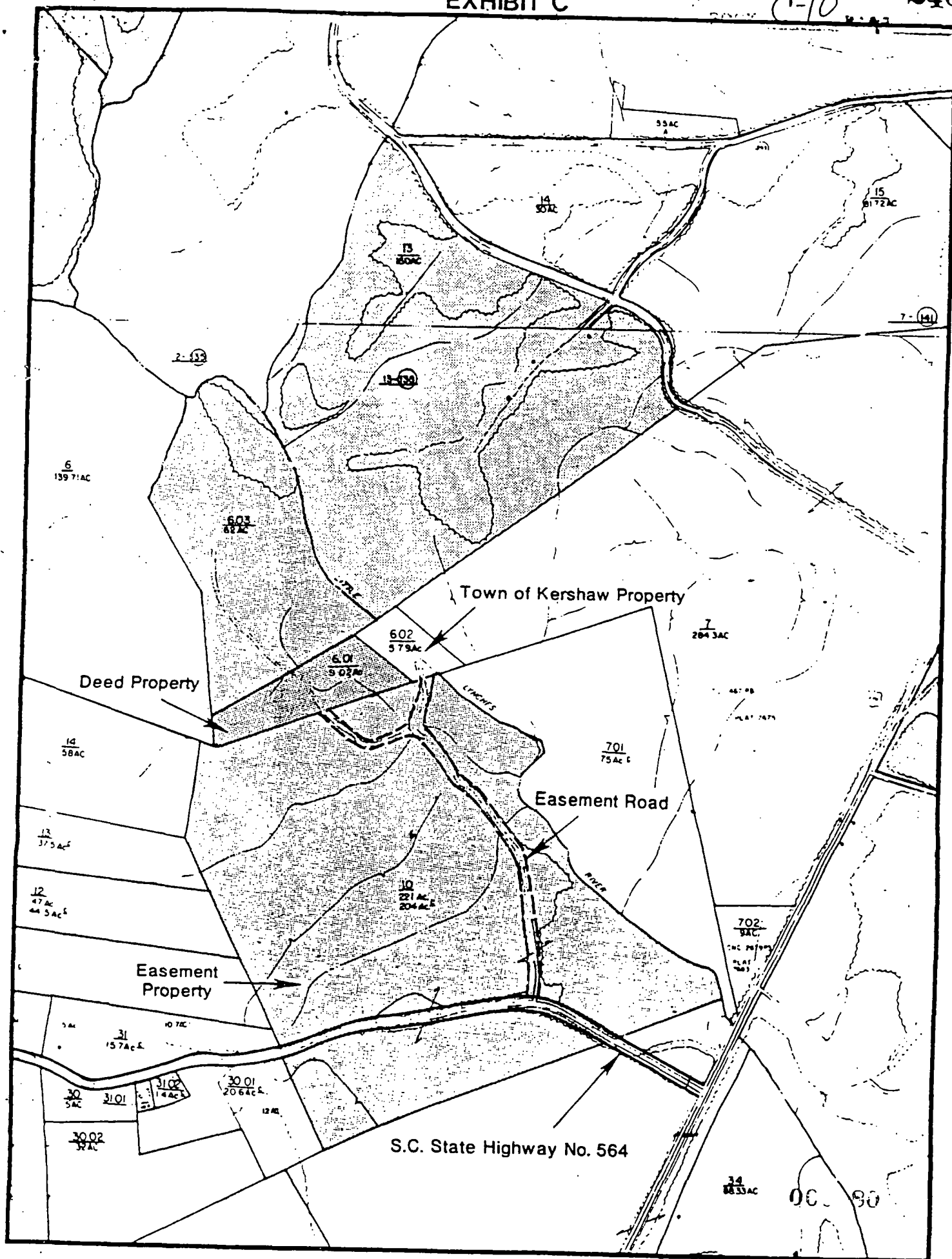
That certain piece, parcel or tract of land containing 14.0 acres, more or less, more particularly described in a plat of a survey entitled "Portion of Haile Gold Mine Tract, property of Kershaw Oil Mill" dated November 3, 1949 and recorded in Plat Book 4 at Page 54 of the Clerk of Court's Office in Lancaster County, South Carolina; less and except a tract of land containing 5.79 acres, more or less, conveyed to the town of Kershaw by a certain Deed by Water Systems and Agreement for service by Springs Mills, Inc., dated March 12, 1975 and recorded in Deed Book B-6 at Page 5162 in said Clerk's Office.

EXHIBIT B
to that certain
DEED AND GRANT OF EASEMENT
from
SPRINGS INDUSTRIES, INC.,
a South Carolina corporation ("Grantor")
to
BREWER GOLD COMPANY,
a Delaware corporation ("Grantee")

EASEMENT PROPERTY

All that piece, parcel or lot of land situated approximately two (2) miles northeast of the town of Kershaw, County of Lancaster, South Carolina, now or formerly bounded on the north by property of T.J. Gregory and the Haile Gold Mine tract, on the east by Lynches Creek and property of Mrs. Truesdale, on the south by property of James T. and Ruth Adams Clyburn, and on the west by property of the Kershaw Oil Mill, James Hegler, Theron Hegler, Mrs. Pat Blackmon and Elmer Baker, with courses and distances as follows: beginning at the southwesterly corner of the property hereby conveyed, said point being S 68 - 23 W 3487.5 feet from the center line of Lynches Creek where said creek is traversed by the northerly property line of James T. and Ruth Adams Clyburn, and at its junction with the southerly and westerly property lines of Mrs. Truesdale, thence with the easterly property lines of the Kershaw Oil Mill, James Hegler, Theron Hegler and Mrs. Pat Blackmon N 26 - 37 W 2750.7 feet to an iron, thence, with the easterly property line of Elmer Baker, N 8 - 35 E 796.6 feet to an iron, being junction of northerly and easterly property lines of Elmer Baker the southeasterly property line of T.J. Gregory and the westerly and northerly property lines of the property hereby conveyed, thence with a portion of the southeasterly property line of T.J. Gregory, S 79 - 25 E 151.9 feet to another iron, being the junction of property lines of T.J. Gregory, Haile Gold Mine tract and the property hereby conveyed thence, with the southerly property line of Haile Gold Mine tract, N 70 - 03 E 1908.3 feet to the center line of Lynches Creek; thence, with the center line of the meandering Lynches Creek, in a generally southeasterly direction, the following several courses and distances: S 48 - 19 E 518.7 feet; S 67 - 54 E 496.7 feet; S 19 - 57 E 107.7 feet; S 50 - 05 W 238.5 feet; S 5 - 55 W 212.6 feet; S 55 - 18 E 304.1 feet; S 36 - 38 E 310.4 feet; S 4 - 55 E 153.9 feet; S 51 - 04 E 339.5 feet; S 62 - 45 E 248.2 feet; S 49 - 50 E 448.1 feet; S 62 - 35 E 331.1 feet; S 76 - 32 E 114 feet; S 14 - 05 E 220.4 feet to a point, the junction of the northerly property line of James T. and Ruth Adams Clyburn and the southerly and easterly property lines of Mrs. Truesdale, said point being 190.1 feet S 68 - 23 W from a Walnut tree, thence, with the northerly property line of James T. and Ruth Adams Clyburn, S 68 - 23 W 3487.5 feet to the point of beginning, containing 221 acres, more or less, all as more clearly appears from a plat thereof, prepared December 8, 1949, and recorded in the office of the Clerk of Court of Lancaster County, South Carolina, in Plat Book 4, at Page 53.

Being the same property conveyed to The Springs Cotton Mills on December 16, 1949, by deed recorded at Book Z-3, Page 393 of the Deed Records of Lancaster County, South Carolina.



LANCASTER COUNTY FEE 8.25
STATE OF S. C. FEE - 0 -
TOTAL FEE 8.25
FEE EXEMPTED _____

FILED BOOK Q-14 PAGE 334
000306 Q-14 pg 330
JAN 31 3 00 PM '97
CLERK OF COURT
LANCASTER COUNTY, SOUTH CAROLINA

QUIT CLAIM DEED AND ASSIGNMENT

Gold Resources, Inc. a Delaware corporation ("Grantor"), in consideration of the sum of Fifteen Thousand Dollars (\$15,000.00), the receipt of which hereby is acknowledged, does hereby convey, transfer, assign and quit claim to Brewer Gold Company, a Delaware corporation ("Grantee"), its successors and assigns, all of Grantor's right, title and interest in and to the following:

(i) that certain letter agreement dated September 13, 1983 between Grantor and NICOR Mineral Ventures Inc., an Illinois corporation, as amended by a Settlement Agreement and Amendment to Agreement, dated effective as of November 6, 1992, between Westmont Gold Inc., a Delaware corporation, Grantor and Grantee;

(ii) certain real property located near the town of Jefferson in Chesterfield County, South Carolina, which property is commonly known as the Brewer Mine property and is more particularly described in Schedule 1 hereto;

(iii) certain real property located near the town of Kershaw in Lancaster County, South Carolina, which property is part of what is commonly known as the Springs property and is more particularly described in Schedule 2 hereto;

(iv) an easement granting, among other things, access to the property described in paragraph (iii) above from South Carolina State Highway 564, pursuant to that certain Deed and Grant of Easement from Springs Industries, Inc., dated September 10, 1991 and recorded in Book C-10, page 231, of the Office of the Clerk of Court of Lancaster County, South Carolina, which easement burdens the lands described in Schedule 3 hereto;

(v) certain real property located near the town of Kershaw in Lancaster County, South Carolina, which property is part of what is commonly known as the Springs property, pursuant to that certain Mineral Lease dated as of September 12, 1983, between Lanny Rhett Gregory, as owner, and Gold Fields Mining Corporation, as lessee, which lease covers the property described in Schedule 4 hereto; and

(vi) certain real property located near the town of Kershaw in Lancaster County, South Carolina, which property is part of what is commonly known as the Springs property, pursuant to that certain Mineral Lease dated as of September 24, 1983, between Mary Lou G. Phillips and Morris Phillips, as owners, and Gold Fields Mining Corporation, as lessee, which lease covers the property described in Schedule 5 hereto.

VERNON MYNARS

NOTARY PUBLIC
AND CLERK OF COURT
LANCASTER COUNTY, SOUTH CAROLINA

001393

001 81

Recorded this 31st day of January, 1997
 of Book 5 Page 90

DATED this 18 day of December, 1996

Thomas W. Tull
 CHESTERFIELD COUNTY ASSESSOR

TMS # 26-14

DATE 1/28/97

GOLD RESOURCES, INC., Chesterfield County, SC

By: [Signature]
 Title: [Signature]

STATE OF New York)
 COUNTY OF West Chester) ss.

The foregoing instrument was acknowledged before me this 18 day of December, 1996 by CORDAN P. REED, as PRESIDENT of Gold Resources, Inc., a Delaware corporation, on behalf of the Corporation.

[seal]

DOLORES R. TRAMA
 Notary Public, State of New York
 No. 4951934
 Qualified in Putnam County
 Commission Expires June 5, 1997

[Signature]
 NOTARY PUBLIC

001394

STATE OF SOUTH CAROLINA)
 COUNTY OF CHESTERFIELD) AFFIDAVIT

PERSONALLY appeared before me J. HASSIE JONES, who being first duly sworn, says that he is Chief Accountant for Brewer Gold Company, and further says that the sum of Fifteen Thousand and no/100 (\$15,000.00) Dollars is the fair market value of the property transferred by the within Deed.

SWORN to before me this
 24th day of January, 1997.

[Signature]
 J. HASSIE JONES

[Signature] (S.)
 NOTARY PUBLIC FOR S.C.
 My Comm. Exp. 9/15/03

Clerk of Court, Chesterfield County
 REVENUE FEE COLLECTED

STATE \$ 39.00
 COUNTY \$ 16.50
 DATE: 1-24-97

FILED
 CLERK OF COURT
 97 JUN 24 PM 1 28
 001394
 CHESTERFIELD COUNTY, SC
 BOOK 355 PAGE 1393
1394

0085656.05

Brewer Gold Company
 Rt 2 Box 57

SCHEDULE 1

Legal Description of the Brewer Mine Property

(Consisting of the following two pages)



All that certain piece, parcel, or tract of land situate, lying, and being in the County of Chesterfield, State of South Carolina, near the Town of Jefferson, South Carolina, known as the "Brewer Mine", containing one thousand (1,000) acres, more or less, said property being more particularly described and bounded as follows, to wit: Starting at a point on the northwest side of the intersection of Highways S. C. 265 and S. C. 110, thence along S. C. 110, north 21 degrees west, 411 feet; then north 34 degrees west 289 feet; then north 40 degrees west 1,500 feet; then north 46 degrees west 150 feet; then north 57 degrees west 200 feet; then north 68 degrees west 177 feet; then north 80 degrees west 212 feet; then south 88 degrees west 157 feet to the line of the property now or formerly owned by Robert Raley; then generally north 25 degrees west 3,341 feet along said property line to an iron at the corner of property now or formerly of Hilton and property now or formerly of McLaughlin; then turning and running in a generally northeasterly direction along property now or formerly of McLaughlin for a total distance of 1,300 feet to a point at the corner of an old cemetery; then turning and running in a generally northwesterly direction along property now or formerly of McLaughlin and Joe Thomas for a total of 2,777 feet to a point 976 feet from Lynches River; then turning and running in a generally northeasterly direction along property now or formerly of C. M. Tucker, Jr., for a total distance of 1,635 feet to some rocks; then turning and running in a generally northerly direction along property now or formerly of C. M. Tucker, Jr., for a total distance of 1,878 feet to some rocks; then turning and running in a generally northeasterly direction for a total distance of 1,981 feet to a pine; then turning and running in a generally southeasterly direction along property now or formerly of Mrs. Ruth Gregory for a total distance of 3,049 feet to a rock on Little Fork Creek; then turning and

-CONTINUED-

S.H.C.
m.i.d.



Revenue Stamps Collected
\$ 24.80
Chesterfield County, S. C.

5th Nov. 1921

600th Dec

880th City

71.7

B.W. atty.

running in a generally southeasterly direction along a line of Little Fork Creek for a total distance of 574 feet to a point on the said creek; then turning and running in a generally southeasterly direction for a total distance of 800 feet to a point on said creek; then turning and running along the line of Little Fork Creek for a total distance of 4,532 feet to a point; then turning and running in a generally southeasterly direction for a total distance of 625 feet to a birch tree; then turning and running in a generally southwesterly direction along property now or formerly of the Attie Gay Estate for a total distance of 2,083 feet to a white oak where said property adjoins that of Evelyn Reid; then turning and running in a generally southeasterly direction along property now or formerly of Evelyn Reid for a total distance of 698 feet to a point located on the northern side of Highway No. 265 at a point approximately one mile from the Town of Jefferson, South Carolina; then turning and running along the northwesterly side of Highway 265 for a total distance of 2,008 feet to the point of commencement: The above-described property is now bounded generally as follows: On the North by lands of Alice G. Tucker and by lands of C. M. Tucker, Jr.; on the Northeast by lands of William Thomas Gregory; on the East by lands of Joe F. Miller, by lands of Jackson V. Gregory, and by lands of others; on the South by South Carolina Road Number S-13-265; and on the West by lands of Canal Industries, Inc., by lands of Harriet G. Herriot, by lands of Billy Franklin Hilton, by lands of Larry H. Bird, et al, by lands of George M. Simpson and B. T. Simpson, by lands of Boise Cascade Corporation, and by lands of Tucker Associates. Said tract of land is more particularly described on a Plat of "Property Known As The Brewer Mine Near The Town Of Jefferson, South Carolina", made by Paul Clark, Registered Surveyor, dated January, 1968, and recorded in the office of the Clerk of Court for Chesterfield County, S. C., in Plat Book 31 at Page 196, and is all the land shown on said Plat lying north and east of South Carolina Road Number S-13-110, a 100-acre tract of land lying south and west of South Carolina Road Number S-13-110 having previously been conveyed by Paul Clark to C. M. Tucker, Jr., by Deed dated August 30, 1974, and recorded in said Clerk's office in Deed Book 231 at Page 596 and by C. M. Tucker, Jr., to Tucker Associates by Deed dated December 31, 1982, and recorded in said Clerk's office in Deed Book 278 at Page 982. 000111

The above-described real estate was conveyed to Paul Clark and C. M. Tucker, Jr., by four (4) Deeds as follows: (1) Deed from First Union National Bank of North Carolina, as Executor of the Estate of T. Carlisle Smith, Deceased, dated January 4, 1968, and recorded in Deed Book 189 at Pages 143-144; (2) Deed from Grace Brown Bongard dated January 10, 1968, and recorded in Deed Book 189 at Pages 145-146; (3) Deed from Hazel Brown McIntosh and A. A. McIntosh dated January 13, 1968, and recorded in Deed Book 189 at Pages 147-148; and (4) Quitclaim Deed from Carolina Mining and Exploration Corporation dated January 13, 1968, and recorded in Deed Book 189 at Pages 141-142, all four (4) Deeds having been recorded in the office of the Clerk of Court for Chesterfield County, South Carolina, on January 15, 1968. On September 20, 1975, Paul Clark died testate devising his interest in the above-described real estate to his widow, Dorothy H. Clark, as evidenced by his Last Will and Testament on file in the office of the Probate Judge for Chesterfield County in Probate File Number 8499. 000000

SCHEDULE 2

Legal Description of the Springs Fee Property

(Consisting of the following one page)



That certain piece, parcel or tract of land containing 14.0 acres, more or less, more particularly described in a plat of a survey entitled "Portion of Haile Gold Mine Tract, property of Kershaw Oil Mill" dated November 3, 1949 and recorded in Plat Book 4 at Page 54 of the Clerk of Court's Office in Lancaster County, South Carolina; less and except a tract of land containing 5.79 acres, more or less, conveyed to the town of Kershaw by a certain Deed by Water Systems and Agreement for service by Springs Mills, Inc., dated March 12, 1975 and recorded in Deed Book D-6 at Page 5162 in said Clerk's Office.

SCHEDULE 3

Legal Description of the Land Burdened by the Springs Easement

(Consisting of the following one page)



All that piece, parcel or lot of land situated approximately two (2) miles northeast of the town of Kershaw, County of Lancaster, South Carolina, now or formerly bounded on the north by property of T.J. Gregory and the Haile Gold Mine tract, on the east by Lynches Creek and property of Mrs. Truesdale, on the south by property of James T. and Ruth Adams Clyburn, and on the west by property of the Kershaw Oil Mill, James Hegler, Theron Hegler, Mrs. Pat Blackmon and Elmer Baker, with courses and distances as follows: beginning at the southwesterly corner of the property hereby conveyed, said point being S 68 - 23 W 3487.5 feet from the center line of Lynches Creek where said creek is traversed by the northerly property line of James T. and Ruth Adams Clyburn, and at its junction with the southerly and westerly property lines of Mrs. Truesdale, thence with the easterly property lines of the Kershaw Oil Mill, James Hegler, Theron Hegler and Mrs. Pat Blackmon N 26 - 37 W 2750.7 feet to an iron, thence, with the easterly property line of Elmer Baker, N 8 - 35 E 796.6 feet to an iron, being junction of northerly and easterly property lines of Elmer Baker the southeasterly property line of T.J. Gregory and the westerly and northerly property lines of the property hereby conveyed, thence with a portion of the southeasterly property line of T.J. Gregory, S 79 - 25 E 151.9 feet to another iron, being the junction of property lines of T.J. Gregory, Haile Gold Mine tract and the property hereby conveyed thence, with the southerly property line of Haile Gold Mine tract, N 70 - 03 E 1908.3 feet to the center line of Lynches Creek; thence, with the center line of the meandering Lynches Creek, in a generally southeasterly direction, the following several courses and distances: S 48 - 19 E 518.7 feet; S 67 - 54 E 496.7 feet; S 19 - 57 E 107.7 feet; S 50 - 05 W 238.5 feet; S 5 - 55 W 212.6 feet; S 55 - 18 E 304.1 feet; S 36 - 38 E 310.4 feet; S 4 - 55 E 153.9 feet; S 51 - 04 E 339.5 feet; S 62 - 45 E 248.2 feet; S 49 - 50 E 448.1 feet; S 62 - 35 E 331.1 feet; S 76 - 32 E 114 feet; S 14 - 05 E 220.4 feet to a point, the junction of the northerly property line of James T. and Ruth Adams Clyburn and the southerly and easterly property lines of Mrs. Truesdale, said point being 190.1 feet S 68 - 23 W from a Walnut tree, thence, with the northerly property line of James T. and Ruth Adams Clyburn, S 68 - 23 W 3487.5 feet to the point of beginning, containing 221 acres, more or less, all as more clearly appears from a plat thereof, prepared December 8, 1949, and recorded in the office of the Clerk of Court of Lancaster County, South Carolina, in Plat Book 4, at Page 53.

Being the same property conveyed to The Springs Cotton Mills on December 16, 1949, by deed recorded at Book Z-3, Page 393 of the Deed Records of Lancaster County, South Carolina.

SCHEDULE 4

Legal Description of the Gregory Property

(Consisting of the following one page)



Legal: "All that piece, parcel or tract of land, containing one hundred fifty (150) acres, more or less, lying, being and situate in Flat Creek Township, Lancaster County, State of South Carolina, and being more particularly bounded and described as follows, to wit: NORTHEAST by road #S-29-294; SOUTHEAST by property of the town of Kershaw and of Champion International; SOUTHWEST BY THE CENTER LINE OF Little Lynches Creek, separating from property this day conveyed to Mary Lou G. Phillips; and NORTHWEST by the center line of Mill Creek, separating from property of Esther and Mary Ada Jenkins."

Reference is made to the following deeds to the Lessor herein for derivation to the above described property: Deed of Annie Grace Gregory, dated February 6, 1981 and recorded in the Office of the Clerk of Court for Lancaster County, South Carolina in Deed Book D-6, page 6319; deed of T. J. Gregory, dated April 18, 1960 and recorded in the Office of the Clerk of Court for Lancaster County, South Carolina in Deed Book K-4, at page 441; deed of B. H. Clyburn, dated January 23, 1948 and recorded in the Office of the Clerk of Court for Lancaster County, South Carolina in Deed Book K-3, at page 38; and, deed of Beckham H. Clyburn, dated December 7, 1938 and recorded in the Office of the Clerk of Court for Lancaster County, South Carolina in Deed Book H-3, at page 437.

SCHEDULE 5

Legal Description of the Phillips Property

(Consisting of the following one page)



"All that piece, parcel or tract of land, containing sixty-two (62) acres, more or less, lying, being and situate in Flat Creek Township, Lancaster County, State of South Carolina, and being more particularly bounded and described as follows, to wit: NORTH by property of Esther and Mary Ada Jenkins; NORTHEAST by the center line of Little Lynches Creek, separating from property conveyed to Lanny Rhett Gregory; SOUTHEAST by property of the town of Kershaw and of Springs Mills, Inc.; and, WEST by property of Betty Lou G. Blackwell, trustee."

Reference is made to the following deeds to the Lessor herein for derivation to the above described property: Deed of Annie Grace Gregory, dated February 6, 1981 and recorded in the Office of the Clerk of Court for Lancaster County in Book D-6, Page 6322; deed of T.J. Gregory, dated April 13 and recorded in the Office of the Clerk of Court for Lancaster County in Deed Book X-4, at page 441; deed of E.E. Clyburn dated January 23, 1948 and recorded in the Office of the Clerk of Court for Lancaster County in Deed Book X-3, at page 38; and, deed of Beckham H. Clyburn, dated December 1, 1938 and recorded in the Office of the Clerk of Court for Lancaster County in Deed Book H-3, at page 437.